Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Civil Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	CE801	PCC	Structural Design & Drawing-IV (Steel)	70	20	10	30	20	150	3	-	2	4
2	CE802	PCC	Estimating Costing and Tendering	70	20	10	30	20	150	3	-	2	4
3	CE803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	CE804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	CE805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	CE803A	Pre-Stressed Concrete
2	CE803B	Pavement Design
3	CE803C	Traffic Engineering

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	CE804A	Finite Element Method
2	CE804B	Air Quality Monitoring & Control
3	CE804C	FRP Composites

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Structural Design & Drawing –IV (Steel)	CE801	PCC	3-0-2	4

STRUCTURAL DESIGN & DRAWING-IV (STEEL)

Course Outcomes-

After the completion of this course student will be able to-

CO1	Estimate loads on steel structure like girders, bridges, chimneys etc.
CO2	Analyse the steel structures on the basis of estimated loads
CO3	Design plate Girder Bridge, trussed girder bridges and bearings for bridges, steel water tanks, guyed self supporting steel stacks Bunkers, Silos and Towers.

MODULE-I

Plate girder bridges (Riveted and welded)

MODULE - II

Trussed girder bridges for railways and highways (RC & IRS holding). Bearings for bridges.

MODULE - III

Water Tanks: Pressed steel tanks, tanks with ordinary plates, square, rectangular, circular with hemispherical bottom and conical bottom.

MODULE-IV

Chimneys: Guyed and self supporting steel stacks.

MODULE-V

Bunkers, Silos & Towers.

Reference Books:-

I. Design of Steel Structures - Ramammutham
2. Design of Steel Structures - Punia
3. Steel Str. by Ramchandra Vol II
4. Steel Str. by Arya& Ajmani
5. Design of steel structures - L.S. Negi

List of Experiment

l Design aid drawing of riveted plate girder bridge.
2. Design and drawing of welded plate girder bridge.
3. Design and drawing of truss girder bridge.
4. Self supporting stack design and drawing.
5 .Design and drawing of pressed steel tank/rectangular tank,
6. Design and drawing of hemispherical bottom circular tank.
7. Design and drawing of steel bunker.
8. Design and drawing of steel silo.

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B.Tech	Estimating Costing and Tendering	CE802	PCC	3-0-2	4

ESTIMATING COSTING AND TENDERING

Course Outcomes-

After the completion of this course student will be able to-

CO1	Illustrate various type of estimate, their purpose and importance.
CO2	Analyse the rates of important item, material and labour requirement for various trades.
CO3	Prepare detailed estimates of construction works such as building , earth work, water supply, etc.
CO4	Evaluate gross income based on depreciation of property, mortgage and lease problems.

MODULE – I

Introduction: Purpose and importance of estimates, principles of estimating. Methods of taking out quantities of items of work. Mode of measurement, measurement sheet and abstract sheet; bill of quantities. Types of estimate, plinth area rate, cubical content rate, preliminary, original, revised and supplementary estimates for different projects.

MODULE-II

Rate Analysis: Task for average artisan, various factors involved in the rate of an item, material and labour requirement for various trades; preparation for rates of important items of work. Current schedule of rates. (C.S.R.)

MODULE-III

Detailed Estimates: Preparing detailed estimates of various types of buildings, R.C.C. works, earth work calculations for roads and estimating of culverts Services for building such as water supply, drainage and electrification.

MODULE-IV

Cost of Works: Factors affecting cost of work, overhead charges, Contingencies and work charge establishment, various percentages for different services in building. Preparation of DPR.

MODULE-V

Valuation: Purposes, depreciation, sinking fund, scrap value, year's purchase, gross and net income, dual rate interest, methods of valuation, rent fixation of buildings.

Reference books:-

1. Hakraborti M "Estimating and Costing" Published by the author 21 B, Bhabananda Road,Calcutta,2002.

2. Dutta B N "Estimating and Costing in Civil Engineering" UBS Publishers' Distributors Ltd., New Delhi, 1999.
3. Birdie G S "Estimating and Costing" Dhanpat Rai & Sons, Delhi,1994.
4. Kohli D. D.,Kohli R.C.,'Estimating and Costing",S.Chand & Company,New Delhi,2004
5.Spence Gedder,"Building and Public Works Administration, Estimating and Costing",Newnes Publishers,London,UK,1950.

LIST OF EXPERIMENTS

1. Preparation of detailed estimate.
2. Detailed estimate for services of plumbing and water supply or Electrification work.
3. Detailed estimate for earth work for the road construction or arched culvert.
4. Rate analysis for at least 8 items of construction.
5. Preparation of DPR of Civil Engineering Project.

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Pre-stressed Concrete	CE803A	PEC	3-0-0	4

PRESTRESSED CONCRETE

Course Outcomes-

After the completion of this course student will be able to-

CO1	Explain different types of pre-stressing systems.
CO2	Analyze different types of prestressed concrete structural members.
CO3	Design pre-stressed concrete simple & continuous beam, slab, column and miscellaneous structural members.
CO4	Calculate pre-stressing losses, short term, long term deflection and crack width.

MODULE-I

Pre-stressing Systems and losses of pre-stressing, introduction various systems of pre-stressing, Types of loss and their analysis.

Working Stress Design of Simple Beams : Critical load conditions allowable stresses, flexural design criteria axially pre-stressed members design of pre-stressing cable for a given cress section, design procedure based on flexure, design by load balancing method and multiple stage pre-stressing.

MODULE - II

Continuous Beams : Analysis of two span beam analysis of two span beam with eccentricities at outer supports, continuous beams with variable section design of continuous beam.

Miscellaneous Structural Members : Columns subjected to combined bending and axial force, piles, poles, piers and abutments, Tension members, ring beams circular tanks and pipes pavement sleepers roads and runways.

MODULE - III : Limit State Design of Beams : Limit state of strength in flexure, shear and torsion permissible stresses limit state of serviceability against deflection. Cracking and durability, design of simply supported and continuous beams.

MODULE - IV

Bond and Anchorage of Pre-stressing cables Bond in pre tensioned and post tensioned construction, prestressing cable at centroid axis symmetric multiple cables causing axial thrust cable with eccentricity,

inclined pre-stressing cable spanning stress, end zone reinforcement.

MODULE-V

Pre-stressed Concrete Slabs : One way slab two way slabs, pre-stressed concrete beam slab construction, pre-stressed flat slab.

Deflection and Crack Width : Factors influencing deflection, short term deflections of un cracked members, long term deflection deflections of cracked members. Estimation of crack width using British code and FIP recommendations.

Reference Books:

l. N.Krishna Raju, Pre-stressed Concrete, Tata Mc Graw Hill Book Co.
2. P. Dayaratran, Pre-stressed Concrete Structures, Oxford & IBH Co. Delhi.
3.Jain & Jai Krishna, Plain & Reinforced Concrete Vol - II Nem chand & Bros Roorkee.
4. IS 1343-980 code of Practice for Pre-stressed Concrete Bureau of India Standards New Delhi.

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Pavement Design	CE803B	PEC	3-0-0	4

PAVEMENT DESIGN

Course Outcomes-

After the completion of this course student will be able to-

CO1	Calculate ESWL, repetition of load and their effects on pavement structures
CO2	Determine stresses in flexible and rigid pavements.
CO3	Design rigid pavements as per IRC methods, PCA Chart methods and AASHTO methods.
CO4	Evaluate and strengthen existing pavement by Benkleman beam method and serviceability index method

MODULE -I

Equivalent Single Wheel Load (ESWL) : Definition, calculation of ESWL, repetition of loads and their effects on the pavement structures.

MODULE -II

Flexible Pavements : Component parts of the pavement structures and their firnctions, stresses in flexible pavements, Stress distribution through various layers, Boussinesque's theory, Burmister's two layered theory, methods of design, group index method, CBR method, Burmister's method and North Dakota cone method.

MODULE -III

Rigid Pavements : Evaluation of subgrade, Modulus-K by plate bearing test and the test details, Westergaard's stress theory stresses in rigid pavements, Temperature stresses, warping stresses, frictional stresses, critical combination of stesses, critical loading positions.

MODULE -IV

Rigid pavement design : IRC method, Fatigue analysis, PCA chart method, joints, design and construction & types, AASHTO Method, Reliability analysis.

MODULE -V

Evaluation and Stengthening of Existing Pavements : Benkleman beam method, Serviceability Index Method. Rigid and flexible overlays and their design procedures.

Reference Books :--

l. Principles of pavement design by E.J.Yoder & M.W. Witczak

2. AASTHO, "A'r{SHO Interim Guide for Design of Pavement Structures", Washington, D.C.
3. Portland Cement Association, Guidlines for Design of Rigid Pavements, Washington
4. DSIR, Conc. Roads Design & Construction.
5 Srinivasan M. "Modern Permanent Way".

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Traffic Engineering	CE803C	PEC	3-0-0	4

TRAFFIC ENGINEERING

Course Outcomes-

After the completion of this course student will be able to-

CO1	Illustrate traffic characteristics, its impact on road traffic, various problems on mass transportation and road accidents
CO2	Practice different traffic studies and give its practical significance
CO3	Design different traffic signal system, traffic islands and street lighting

MODULE -I

Traffic Characteristics: (i) Road user's characteristics - general human characteristics, physical, mental and emotional factors, factors affecting reaction time, PIEV theory. (ii) Vehicular characteristics: Characteristics affecting road design-width, height, length and other dimensions.

weight, power, speed and braking capacity of a vehicle.

MODULE -II

Traffic Studies: (i) Spot Speed Studies and Volume Studies.(ii) Speed and Delay Studies purpose, causes of delay, methods of conducting speed and delay studies. (iii) Origin and destination Studies (O & D): Various methods, collection and interpretation of data, planning and sampling. (iv)Traffic Capacity Studies: Volume, density, basic practical and possible capacities, level of service. (v) Parking Studies: Methods of parking studies cordon counts, space inventories, parking practices.

MODULE -III

Traffic Operations and Control: (i) Traffic regulations and various means of control.(ii) One way streets- advantages and limitations. (iii) Traffic signals- isolated signals, coordinated signals, simultaneous, alternate, flexible and progressive signal systems. Types of traffic signals, fixed time signals, traffic actuated signals, speed control signals, pedestrian signals, flashing signals, clearance interval and problems on single isolated traffic signal.

MODULE -IV

Street Lighting: (i) Methods of light distribution. (ii) Design of street lighting system. (iii) Definitions- Luminaire, foot candle, Lumen, utilization and maintenance factors. (iv) Different types of light sources used for street lighting. (v) Fundamental factors of night vision.

MODULE -V

Accident Studies & Mass Transportation: (i) Accident Studies: Causes of accidents, accident studies and records, condition and collision diagram, preventive measures. (ii) Expressways and freeways, problems on mass transportation and remedial measures, brief study of mass transportation available in the country.

Reference Books :-

1. Traffic Engineering and Transport Planning by L.R. Kadiyali, Khanna Publishers, Delhi
2. Traffic Engineering by Matson, W.S.Smith& F.W. Hurd
3. G.J. Pingnataro, Principles of Traffic Engineering
4. D.R.Drew, Traffic Flaw Theory
5. W.R. Mchsne and R.P. Roess "Traffic Engg"
6. Wohl& Martin, Traffic System Analysis for Engineering & Planners

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Finite Element Method	CE804A	OEC	3-0-0	4

FINITE ELEMENT METHOD

Course Outcomes-

After the completion of this course student will be able to-

CO1	Explain concepts of FEM, plane stress, strain and discretization of structures.
CO2	Derive shape functions for various type of elements
CO3	Determine stiffness matrix for spring, bar and beam elements.
CO4	Perform numerical integration using Gauss Quadrature.

MODULE I

Introduction- Introduction to Finite Element Method, Comparison with other methods, Basic concepts of finite element method, Introduction to boundary value and initial value problems, Introduction to stiffness matrix and boundary conditions.

MODULE II

Shape Functions & Discretization of Structures- Introduction of shape functions, polynomials, convergence requirements of shape functions, derivation of shape functions, Hermite and Lagrange polynomials. Introduction to discretization of structure, Nodes as discontinuities, Refining mesh, Use of symmetry, Element aspect ratio, Higher order element, Elements numbering.

MODULE III

Spring, Bar & Beam Element- One dimensional second order equations, Derivation of stiffness matrix for a spring element, Direct stiffness method, Potential energy approach to derive spring element equations, Derivation of stiffness matrix for a bar element in local coordinates, Selection of approximation function, Beam stiffness, assemblage of beam stiffness matrix, potential energy approach to derive beam element equations, Analysis of beam using two noded elements, Galerkin's Residual method.

MODULE IV

Plane stress and plane strain problems- Introduction, CST (Constant Strain Triangle) element, finite element solution of plane strain problem, Explicit expression for CST stiffness matrix.

MODULE V

Isoparametric formulation- Coordinate transformation, Bar element, Rectangular plane stress element, Numerical integration, Gauss Quadrature.

Reference Books:

1. Chandrupatla, T.R., and Belegundu, A.D., "Introduction to Finite Element in Engineering", Third Edition, Prentice Hall, India, 2003.
2. Bhavikati, S. S., "Finite Element Analysis", New Age International Publishers, 2005.
3. Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning, 2011.

4. J. N. Reddy, "An Introduction to Finite Element Method", McGraw-Hill, Intl. Student Edition, 1985.
5. Zienkiewics, "The finite element method, Basic formulation and linear problems", Vol.1, 4/e, McGraw-Hill, Book Co.
6. S. S. Rao, "The Finite Element Method in Engineering", Pergaman Press, 2003.
7. C. S. Desai and J. F. Abel, "Introduction to the Finite Element Method", Affiliated East West Press, 1972.

Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	Air Quality Monitoring & Control	CE804B	OEC	3-0-0	4

AIR QUALITY MONITORING & CONTROL

Course Outcomes-

After the completion of this course student will be able to-

CO1	Identify the sources of air pollution.
CO2	Relate general diseases and toxicity of pollutants.
CO3	Explain the design and operation of various air pollution control equipments.
CO4	Apply air pollution control legislation, public education pollution standards, etc. to practice.

MODULE- I

Air-pollution : Definition, Atmosphere and global effects, Pollutants and their sources, classification. Air Pollution Meteorology : Interaction of Meteorology parameters, Transport and Diffusion Models and mechanism, Wind rose diagram, Particulates Visibility. Dynamics of pollutant dispersion and disposal. Effects on environment including living and non-living matter.

MODULE- II

Air Pollutant Chemistry: Properties of Pollutant, Units for expression of concentrations, Effects on Vegetation, Physical Environment and Human Health Mechanisms of Effect, Estimation Methodology. Human Health Hazard: Units of Measurement, Measurement of Concentration on Human Health. Nature of process Emissions: Mobile Combustion. Sources, Stationary Source, Measurement of Monitoring.

MODULE- III

Ambient air quality monitoring techniques: Air pollution indices, standards, norms, rules and regulations. Removal processes. An introduction to air pollution meteorology. Air Laboratory - High Volume Sampling, Handy Sampling, Bio aerosols sampling, Indoor Air Sampling, Stack Sampling.

MODULE- IV

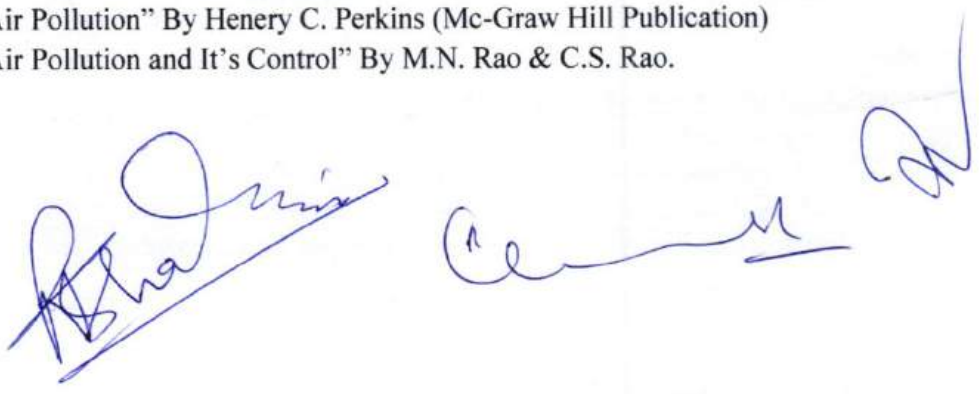
Prevention and Control of Air Pollution: Regulated Release of Air Pollutant Practicability, Mechanisms of Control, Equipment Mathematical Model of Control Processes, Mechanical Collectors, Wet Collectors, Filtration, Electrostatics Precipitators Of Form Bed Reactors and Ventury Scrubbers, After Burners And Dispersion. Industrial Application: Wood Working Operation, Open Hearth Neel Making, Manufacture of Sulfuric Acid, Coffee Roasting, Environmental Industrial Location, Theories And Facilities, Impact of Industrial Products.

MODULE- V

Legislation : Standards of Air Qualities in Various Countries , Evolution of Standards, Standards and Criteria, Emission Standards and Air Qualities Standards, Clean Air Act, Total Environmental Protection, Social Responsibility, Economics and Production..

Reference Books :

1. "Air Pollution : It's Origin and Control" By Kenneth Wark & Cecil F. Warner.
2. "Air Pollution Control Volume (I to VII)" By A.C. Stern.
3. "Air Pollution" By Henery C. Perkins (Mc-Graw Hill Publication)
4. "Air Pollution and It's Control" By M.N. Rao & C.S. Rao.



Course	Subject Title	Subject Code	Category Code	Hours/week	Total Credits
B. Tech	FRP Composites	CE804C	OEC	3-0-0	4

FRP COMPOSITES

Course Outcomes-

After the completion of this course student will be able to-

CO1	Illustrate selection criteria for materials selection.
CO2	Choose different types of fibre for FRP composites.
CO3	Explain types of molds and manufacturing processes.

MODULE-I

Introduction- Composites- Advantages of FRP –Role of resin and reinforcements - Applications of FRP. Designing in FRP – Selection criteria - material and process selection

MODULE-II

Molds for FRP- Polyester resins. Introduction – Plaster mold, wooden Mold - GRP molds- Epoxide moldsSteel molds- Aluminum alloy molds- Nickel shell molds.

MODULE-III

Reinforcements- Introduction - Surfacing tissue –Glass fiber - Continuous filament rovings- Chopped strands- Chopped strand mats- Continuous strand mat Woven glass fabrics- Carbon fiber- Aromatic polyamide (aramid) fibers - Polyester fibers- Polyacrylonitrile fibers - Nylon - PVC and PVDC Cotton – Sisal - Asbestos– Jute- Boron fibers

MODULE-IV

Molding Processes- Introduction - Contact molding -hand lay up - Spray lay-up- Vacuum bag molding - Pressure bag molding – Resin transfer or resin injection molding-pressure injection- Vacuum impregnation and injection - Hot press/matched metal molding - Filament winding- Centrifugal molding - Continuous sheet manufacture – Pultrusion - Sandwich construction.

MODULE-V

Bulk, Dough and Sheet molding Compounds and Prepregs. Introduction- Dough and bulk molding compounds - Sheet mould compounds- manufacture of SMC- Prepregs - Commercial products.

Reference Books:

1. FRP TECHNOLOGY by Weatherhead.

2. FIBERREINFORCED COMPOSITES- Materials, Manufacturing, and Design by P.K. Mallick
3. COMPOSITES MANUFACTURING- Materials, Product, and Process Engineering by Sanjay K. Mazumdar
4. Hand book of Reinforcement for plastics – Milewski .
5. M O W Richardson "Polymer Engineering Composite" – Applied Science.

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(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Computer Science & Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	CS801	PCC	Network Management	70	20	10	30	20	150	3	-	2	4
2	CS802	PCC	Data Warehousing & Mining	70	20	10	30	20	150	3	-	2	4
3	CS803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	CS804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	CS805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	CS803A	Distributed Systems & Cloud Computing
2	CS803B	Ethical Hacking
3	CS803C	Embedded Systems

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	CS804A	Data Analytics
2	CS804B	E-Commerce & ERP
3	CS804C	Simulation and Modeling

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit

1 hour Tutorial (T) = 1 credit

2 hour Practical (P) = 1 credit

Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS801	Network Management	70	20	10	30	20	150	3	-	2	4

Module-I: Introduction to Network Managements:Network Management Framework, Network Based Managements, Evolution of Network Management: SGMP, CMIP, SNMP. Network Implementation and Management Strategies, Network Management Categories: Performance Management, Fault Management, Configuration Management, Security Managements, Accounting Managements. Network Management Configuration: Centralized Configuration, Distributed Configuration. Selected Management Strategy.

Module-II: Management Information Base (MIB), Structure of Management Information, NMS Presentation of the SMI, NMS Meter-ware Network View. Remote Monitoring (RMON), RMON Group.
Desktop Management: Desktop Management Interface (DMI), DMI Architecture, DMI Browser, DMI/SNMP Mapping, Desktop SNMP Extension Agents. Setting up LAN Access, SNMP Configuration.

Module-III: OSI Layering, TCP/IP Layering, Protocols & Standards, Internet standards, Internet administration, Internet Addresses, Internet protocol: introduction, IP header, IP routing, Subnet addressing, subnet mask, special case of IP addresses, Comparative Study of IPV4 & IPV6, port numbers Address Resolution Protocol, ARP packet format, Proxy ARP, ARP command, ARP Example, Reverse Address Resolution Protocol (RARP): Introduction, RARP Packet format, RARP Examples, RARP server design.

Module-IV: Delivery and Routing of IP Packets, Routing Methods, Static versus Dynamic Routing, Routing table and Routing Module, Classless Addressing: CIDR. Internet Protocol (IP), Datagram, Fragmentation, Options, IP Package. Interior and Exterior Routing, Routing information protocol (RIP), Open shortest path first protocol (OSPF), BGP, GGP. Private Networks. Virtual Private Network (VPN), Network Address Translation (NAT).

Module-V: Internet Control Message Protocols (ICMP):- Types of message, message format, error reporting, query, checksum, ICMP Package. IGMP, IGMP Message and its Operation, IGMP Package.
Transmission control protocol, Process-to-Process Communication, TCP Services Flow Control, TCP Timers. TCP Operation, TCP Package. Application layers protocols Telnet Protocol, File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), X-Window system protocol, Remote procedure call, and Network file system.

Suggested Books:

1. Forouzan, TCP/IP Protocol Suite 4th edition, TMH
2. J.RichardBurkey, Network Management Concept and Practice, PHI
3. Stevens, TCP/IP Illustrated Volume-I, Pearson
4. Tittel: TCP/IP, Cenage Learning
5. Uyless Black, TCP/IP and related protocols, McGraw Hill.
6. Doughals E. Comer, Internetworking with TCP/IP Vol. I, Principles, Protocols, and Architecture, Prentice Hall, India.

CS801 (Network Management)

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Explain and demonstrate Network Managements Architecture, Routing & Protocols used for Network Management.
CO2: Select Routing methods and Protocols for Network Based Managements & Construct Computer Network.
CO3: Compare Routing Strategies, Networks Configuration and various protocols
CO4: Select network management Protocols & Maintain the network by performing routine maintenance tasks.

Jabalpur Engineering College, Jabalpur
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B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS802	Data Warehousing & Mining	70	20	10	30	20	150	3	-	2	4

Module-I: Data Warehousing: Introduction, Delivery Process, Data warehouse Architecture, Data Preprocessing: Data cleaning, Data Integration and transformation, Data reduction. Data warehouse Design: Data warehouse schema, Partitioning strategy Data warehouse Implementation, Data Marts, Meta Data, and Example of a Multidimensional Data model. Introduction to Pattern Warehousing.

Module-II: OLAP Systems: Basic concepts, OLAP queries, Types of OLAP servers, OLAP operations etc. Data Warehouse Hardware and Operational Design: Security, Backup and Recovery.

Module-III: Introduction to Data & Data Mining: Data Types, Quality of data, Data Preprocessing, Similarity measures, Summary statistics, Data distributions, Basic data mining tasks, Data Mining V/s knowledge discovery in databases. Issues in Data mining. Introduction to Fuzzy sets and fuzzy logic.

Module-IV: Supervised Learning: Classification: Statistical-based algorithms, Distance-based algorithms, Decision tree-based algorithms, neural network-based algorithms, Rule-based algorithms, Probabilistic Classifiers
Advanced techniques: Text mining: extracting attributes (keywords), structural approaches (parsing, soft parsing). Bayesian approach to classifying text Web mining: classifying web pages, extracting knowledge from the web
Data Mining software and applications

Module-V: Clustering & Association Rule mining: Hierarchical algorithms, Partitional algorithms, Clustering large databases BIRCH, DBSCAN, CURE algorithms, Association rules: Parallel and distributed algorithms such as Apriori and FP growth algorithms.

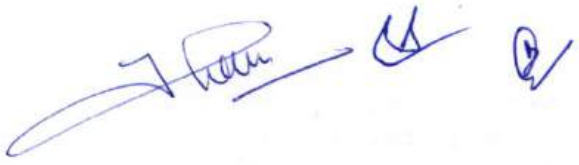
Suggested Books:

1. Pang-Ning Tan, Steinbach & Kumar, *"Introduction to Data Mining"*, Pearson Education.
2. Data Mining Techniques; ArunK.Pujari; University Press.
3. Jaiwei Han, MichelineKamber, "*Data Mining : Concepts and Techniques*", Morgan Kaufmann Publishers.
4. Anahory& Murray, "*Data Warehousing in the Real World*", Pearson Education.
5. Margaret H. Dunham, "*Data Mining : Introductory and Advanced topics*", Pearson Education.
6. Data Mining; Adriaans&Zantinge; Pearson education.
7. Mastering Data Mining; Berry Linoff; Wiley.

CS802 (Data Warehousing & Mining)

Upon completion of the course, the students will be able to

CO1: Understand the functionality of the various data mining and data warehousing component.
CO2: Analyze OLAP tools.
CO3: Apply Data Mining Techniques and methods on large data sets.
CO4: Compare and contrast classification and prediction techniques.
CO5: Explain data mining tools on various applications and understand the basics of big data analytics.



Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS803A	Distributed Systems & Cloud Computing	70	20	10	-	-	100	3	-	-	3

Module-I: Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks; Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.

Module-II: Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.

Module-III: Agreement Protocols: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems, Mechanism for building distributed file systems, Design issues in Distributed Shared Memory, Algorithm for Implementation of Distributed Shared Memory.

Module-IV: Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Commit Protocols, Voting protocols, Dynamic voting protocols

Module-V: Cloud Computing Definition: Cloud Types: private, public and hybrid cloud. Cloud computing Services: IaaS, PaaS, SaaS. Introduction to cloud Virtualization concepts. Types of Virtualization & its benefits. Benefits and challenges of cloud computing, Next generation Cloud Applications.

Suggested Books:

1. Singhal& Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill
2. Ramakrishna,Gehrke," Database Management Systems", McGraw Hill
3. Vijay K.Garg Elements of Distributed Computing, Wiley
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education 5. Tenanuanbaum,Steen," Distributed Systems", PHI
5. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, .
6. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press.

CS803A (Distributed System & Cloud Computing)

Upon completion of the course, the students will be able to

CO1: Explain fundamental concepts of Distributed System and Cloud Computing.
CO2: Classify various architectural and fundamental models of distributed system design.
CO3: Apply the election algorithms in a given scenario to select the coordinator.
CO4: Analyse different agreement protocols and communication protocols like RPC, RMI etc. in Distributed systems.
CO5: Examine various deadlock handling mechanisms in distributed environment.

Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS803B	Ethical Hacking	70	20	10	-	-	100	3	-	-	3

Module-1: Ethical Hacking: Types of Data Stolen From the Organizations, Elements of Information Security, Authenticity and Non-Repudiation, Security Challenges, Effects of Hacking, Hacker – Types of Hacker, Ethical Hacker, Hacktivism - Role of Security and Penetration Tester, Penetration Testing Methodology, Networking & Computer Attacks – Malicious Software (Malware), Protection Against Malware, Intruder Attacks on Networks and Computers, Addressing Physical Security – Key Loggers and Back Doors.

Module-II: Foot Printing And Social Engineering: Web Tools for Foot Printing, Conducting Competitive Intelligence, Google Hacking, Scanning, Enumeration, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering – shoulder surfing, Dumpster Diving, Piggybacking.

Module-III: Data Security: Physical Security – Attacks and Protection, Steganography – Methods, Attacks and Measures, Cryptography – Methods and Types of Attacks, Wireless Hacking, Windows Hacking, Linux Hacking.

Module-IV: Network Protection System & Hacking Web Servers: Routers, Firewall & Honeypots, IDS & IPS, Web Filtering, Vulnerability, Penetration Testing, Session Hijacking, Web Server, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobiles Phone Hacking.

Module-V: Ethical Hacking Laws And Tests: An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking, ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking – Social Engineering, Host Reconnaissance, Session Hijacking, Hacking - Web Server, Database, Password Cracking, Network and Wireless, Trojan, Backdoor, UNIX, LINUX, Microsoft, NOVEL Server, Buffer Overflow, Denial of Service Attack, Methodical Penetration Testing.

Suggested Books:

1. Michael T. Simpson, Kent Backman, James E. "Corley, Hands-On Ethical Hacking and Network Defense", Second Edition, CENGAGE Learning.
2. Steven DeFino, Barry Kaufman, Nick Valenteen, "Official Certified Ethical Hacker Review Guide", CENGAGE Learning.
3. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy", Syngress Basics Series –Elsevier.
4. Whitaker & Newman, "Penetration Testing and Network Defense" , Cisco Press, Indianapolis.

CS803B (Ethical Hacking)

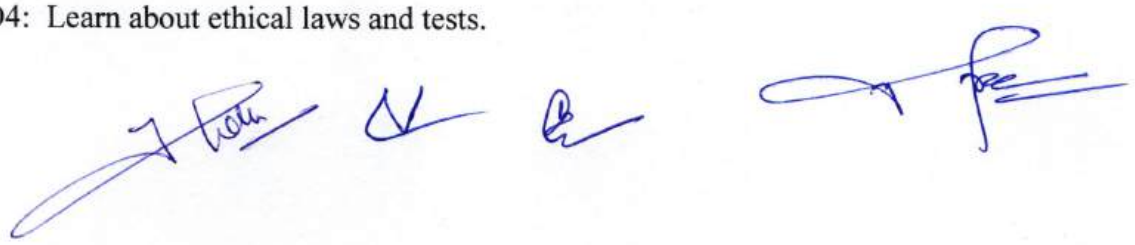
Upon completion of the course, the students will be able to.

CO1: Understand how intruders escalate privileges.

CO2: Understand Intrusion Detection, Policy Creation, Social Engineering, Buffer.

CO3: Define overflows and different types of Attacks and their protection mechanism.

CO4: Learn about ethical laws and tests.



Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS803C	Embedded Systems	70	20	10	-	-	100	3	-	-	3

Module-I: Introduction to Embedded Systems: Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, classification, major application areas, purpose of embedded systems, characteristics and quality attributes of embedded systems, common design metrics, and processor technology: general purpose processor, application specific processor, single purpose processor.

Module-II: Embedded System Architecture: Von Neumann v/s Harvard architecture, instruction set architecture, CISC and RISC instructions set architecture, basic embedded processor, microcontroller architecture, CISC & RISC examples: 8051, ARM, DSP processors.

Module-III: Input Output and Peripheral Devices Timers and counters, watchdog timers, interrupt controllers, PWM, keyboard controller, analog to digital converters, real time clock. Introduction to communication protocols: basic terminologies, concepts, serial protocol: I2C, CAN, firewire, USB. Parallel protocols: PCI bus, IrDA, bluetooth, IEEE 802.11, wireless protocols.

Module-IV: Memory System Architecture Caches, virtual memory, MMU, address translation, memory and interfacing, memory write ability and storage performance. Memory types, composing memory – advance RAM interfacing, microprocessor interfacing I/O addressing, interrupts, direct memory access, arbitration multilevel bus architecture.

Module-V: Embedded System Supporting Technologies Difference between normal OS and RTOS, scheduling algorithms. Case study: Tiny OS, VxWorks, QNX. Overview of VLSI technology, introduction to device drivers. Case studies: washing machine, air-conditioning, auto focus camera. References:

Suggested Books:

1. F Vahid, T Giogarvis, Embedded systems: A unified hardware/software approach, Wiley.
2. Raj Kamal, Embedded Systems Introduction, 2nd Ed., TMH publication.
3. David E Simons, An Embedded Software Primer, Pearson.
4. Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.
5. 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi, Janice Mazidi and Janice Gillispie Mazidi

CS803C (Embedded Systems)

Upon completion of this course, students will be able to.

CO1: Explain the embedded system concepts and architecture of embedded systems

CO2: Describe the architecture of 8051 microcontroller and write embedded program for 8051 microcontroller.

CO3: Select elements for an embedded systems tool.

CO4: Understand the memory types used in embedded systems.

CO5: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS804A	Data Analytics	70	20	10	-	-	100	3	-	-	3

Module-I:Data Definitions and Analysis Techniques: Elements, Variables, and Data categorization, Levels of Measurement, Data management and indexing Introduction to Statistical Concepts: Sampling Distributions, Resampling, Statistical Inference, and R-Programming Descriptive Statistics Measures of central tendency Measures of location of dispersions.

Module-II:Basic Data analysis techniques: Statistical hypothesis generation and testing, Chi-Square test, t-Test Analysis of variance Correlation analysis, Maximum likelihood test

Module-III:Advance Data analysis techniques: Regression Modelling, Multivariate Analysis, Bayesian Modeling, Inference And Bayesian Network, Regression analysis, Classification techniques, Clustering Techniques Clustering Association rules analysis

Module-IV:Frameworks and Visualization: MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed File Systems – Visualizations – Visual Data Analysis Techniques, Interaction Techniques; Systems and Applications

Module-V:Case studies and projects: Understanding business scenarios, Feature engineering and visualization, Scalable and parallel computing with Hadoop and Map-Reduce Sensitivity Analysis, Case Studies – Real Time Sentiment Analysis, Stock Market Predictions.

Suggested Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer.
2. AnandRajaraman And Jeffrey David Ullman, Mining Of Massive Datasets,Cambridge University Press.
3. Bill Franks, Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analystics, John Wiley & Sons.
4. Glenn J. Myatt, Making Sense Of Data, John Wiley & Sons, 2007 Pete Warden, Big Data Glossary, O"Reilly.
5. Jiawei Han, MichelineKamber "Data Mining Concepts And Techniques", Second Edition, Elsevier, Reprinted.

CS804A (Data Analytics)

Upon completion of the course, the students will be able to.

CO1: Understand the key issues in data management and its associated applications in intelligent business and scientific computing.

CO2: Acquire fundamental enabling techniques and scalable algorithms like Hadoop, Map Reduce and NO SQL in data analytics.

CO3: Interpret basic and advanced data analytics models and apply software tools for data analytics.

CO4: Achieve adequate perspectives of data analytics in various applications like recommender systems, social media applications etc.

Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS804B	E-Commerce & ERP	70	20	10	-	-	100	3	-	-	3

Module-I: Introduction and Concepts: Networks and commercial transactions – Internet and other novelties; networks and electronic transactions today, Model for commercial transactions; Internet environment – internet advantage, worlds wide web and other internet sales venues; Online commerce solutions.

Module-II: Electronic Payment Methods: Updating traditional transactions; Secure online transaction models; Online commercial environments; Digital currencies and Payment systems; Offline secure processing; private data networks. Security protocols.
Electronic Commerce Providers:On-line Commerce options: Company profiles. Electronic Payment Systems: Digital payment systems-First virtual internet payment system; cyber cash model. On-line Commerce Environments: Servers and commercial environments; Ecommerce servers.

Module-III: Digital Currencies: Operational process of Digicash, Ecash Trail; Using Ecash-; Smart cards; Electronic Data Interchange: basics, EDI versus Internet and EDI over Internet. Strategies, Techniques and Tools-, shopping techniques and online selling techniques.

Module-IV: ERP- An Enterprise Perspective Production Finance, Personnel disciplines and their relationship, Transiting environment, MIS Integration for disciplines, Information/Workflow-, Network Structure, Client Server Integrator System, Virtul Enterprise—Kandarp . ERP – Resource Management Perspective: Functional and Process of Resource. Management, Introduction to basic Modules of ERP System: HRD, Personnel Management, Training and Development, Skill Inventory, Material Planning and Control, Inventory, Forecasting, Manufacturing, Production Planning, Production Scheduling, Production Control, Sales and Distribution, Finance, Resource Management in global scenario.

Module-V: ERP - Information System perspective: Introduction to OLAP (Online Analysis and Processing), TP, OAS, KBS, MRP, BPR, SCM, REP, CRM, Information Communication Technology-.ERP-Key Managerial issues : Concept Selling, IT Infrastructure, Implication, of ERP Systems on Business Organization, Critical success factors in ERP System, ERP Culture Implementation Issues, Resistance to change, ERP Selection issues, Return on Investment, Pre and Post Implementation Issues.

Suggested Books:

1. Ravi kalakota, Andrew Whinston , "Frontiers of electronic Commerce", Addision Wesley.
2. V.K. Garg and N.K. Venkita Krishna, "Enterprise Resource Planning-Concepts and Practice", PHI Publications.
3. Greenstein and Feinman, "E Commerce", Tata McGraw Hill, 3rd edition.
4. Greenstein, Feinman, "Electronic Commerce – Security, Risk management and Control" , Tata McGraw Hill.

CS804B (E-commerce and ERP)

Course Outcomes: On successful completion of the course, the students will be able to:

CO1: Demonstrate an understanding of the foundations and importance of E-commerce&ERP.
CO2: Analyze the impact of E-commerce& ERP on business models and strategy
CO3: Describe Electronic Payment Methods, Digital Currencies, ERP - Information System perspective & Simplify ERP-Key Managerial issues
CO4: Discuss legal issues and privacy in E-Commerce, Choose electronic payment systems& Improve ERP-Resource Management.

Jabalpur Engineering College, Jabalpur
(AICTE Model Curriculum based scheme)
B. Tech. (AICTE) VIII Sem. (Computer Science & Engineering)

Subject code	Subject Name & Title	Maximum Marks Allotted						Hours/Week			Total Credits
		Theory			Practical			L	T	P	
		End Sem	Mid Sem Exam	Quiz, Assignment	End Sem	Lab Work	Total Marks				
CS804C	Simulation & Modeling	70	20	10	-	-	100	3	-	-	3

Module-I: Modeling & Simulation Concepts Modeling & Simulation Concepts: System Concepts, What is a Model? Type of Models, Modeling & Simulation, Continuous vs. Discrete System Simulation, Numerical Integration vs. Continuous Simulation, Analog vs. Digital Simulation, Simulation vs. Monte- Carlo Simulation, Nature of Computer Modeling and Simulation, When to Use Simulation? Limitations of Simulation

Module-II: Probability Concepts in Simulation Stochastic variables, Random numbers: Pseudo-random generators, Testing of Pseudo-random number generators, Generation of non-uniformly distributed random numbers, discrete and continuous random variables, and density and distributive functions. Study of few distributions such as Poisson, Normal, Uniform

Module-III: Simulation of Continuous Systems Introduction, Differential equations, Pure Pursuit Problem, Simulation of Chemical Reaction, Autopilot Simulation and Simulation of other Continuous systems

Module-IV: Simulation of Discrete Systems Arrival patterns and service times, Simulation of Queuing System - Elementary idea about networks of Queuing with particular emphasis to computer system environment

Module-V: Verification & Validation Design of simulation experiments and validation of simulation experiments comparing model data units and real system data Simulation Language A brief introduction to important discrete and continuous languages such as GPSS (Study & use of the language). Use of data base & AI techniques in the area of modeling and simulation

Suggested Books:

1. Deo, Narsing "System Simulation with Digital Computers"
2. Gorden G, "System Simulation", Prentice Hall
3. Shridhar Bhai Trivedi, Kishore "Probability & Statistics with reliability Queuing, Computer Science Applications"
4. Payer, T.A., "Introduction to System Simulation", McGraw Hill
5. Reitman, J, "Computer Simulation Application", Wiley
6. Barnes B, "Modeling and Performance Measurement of Computer System
7. Spriet, WIA. "Computer Aided Modeling and Simulation (Academic Press).

CS804C (Simulation & Modeling)

Course Outcomes: After the completion of this course, the students will be able to:

CO1: Define, describe and apply basic concepts related to modeling, identification and simulation.

CO2: Classify various simulation models and give practical examples for each category.

CO3: Demonstrate the ability to apply knowledge of probability and statistics for simulation & modeling.

CO4: Generate and test random numbers and apply them to develop simulation models.

CO5: Construct a model for a given set of data and motivate its validity.

Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Electronics & Telecommunication Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	EC801	PCC	Optical Communication	70	20	10	30	20	150	3	-	2	4
2	EC802	PCC	Advance Communication	70	20	10	30	20	150	3	-	2	4
3	EC803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	EC804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	EC805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	EC803A	Nano Electronics
2	EC803B	System on Chip Design
3	EC803C	Sensor Technology

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	EC804A	Economics & Social Issues
2	EC804B	I.O.T.
3	EC804C	Fuzzy Logic & NN

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
Established in 1947 as Government Engineering College, Jabalpur
(Declared autonomous by Govt. of M.P. in 1998)
COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B. Tech. VIII SEM EC	Optical Communication	EC801	3	-	2	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Module-I

Overview of Optical Fiber Communications (OFC): Motivation, optical spectral bands, key elements of optical fiber systems. **Optical fibers**: basic optical laws and definitions, optical fiber modes and configurations, mode theory for circular waveguides, single mode fibers, graded-index fiber structure, fiber materials, photonic crystal fibers, fiber fabrication, fiber optic cables.

Module -II

Optical sources: Light emitting diodes (LEDs): structures, materials, quantum efficiency, LED power, modulation of an LED. Laser diodes: modes, threshold conditions, laser diode rate equations, external quantum efficiency, resonant frequencies, structure and radiation patterns, single mode lasers, modulation of laser diodes. **Power launching and coupling**: source to fiber power launching, fiber to fiber joints, LED coupling to single mode fibers, fiber splicing, optical fiber connectors. Multimode fibers.

Module -III

Photo detectors: pin photo detector, avalanche photodiodes, photo detector noise, detector response time, avalanche multiplication noise. **Signal degradation in optical fibers:** Attenuation: units, absorption, scattering losses, bending losses, core and cladding losses. Signal distortion in fibers: overview of distortion origins, modal delay, factors contributing to delay, group delay, material dispersion, waveguide dispersion, polarization-mode dispersion. Characteristics of single mode fibers: refractive index profiles, cutoff wavelength, dispersion calculations, mode field diameter, bending loss calculation. Specialty fibers.

Module-IV Optical receivers: fundamental receiver operation, digital receiver performance, eye diagrams, coherent detection: homodyne andheterodyne, burst mode receiver, analog receivers. **Digital links**: point to point links, link power budget, rise time budget, power penalties. **Analog links**: overview of analog links, carrier to noise ratio, multichannel transmission techniques.

Module -V

Optical technologies Wavelength division multiplexing (WDM) concepts: operational principles of WDM, passive optical star coupler, isolators, circulators, Active optical components: MEMS technology, variable optical attenuators, tunable optical filters, dynamic gain equalizers, polarization controller, chromatic dispersion compensators. **Optical amplifiers**: basic applications and types of optical amplifiers, Erbium Doped Fiber Amplifiers (EDFA): amplification mechanism, architecture, power conversion efficiency and gain. Amplifier noise, optical SNR, system applications. CWDM & DWDM.

Performance Measurement and monitoring: measurement standards, basic test equipment, optical power measurements, optical fiber characterization, eye diagram tests, optical time-domain reflectometer, optical performance monitoring.

References:

1. G. Keiser: Optical Fiber Communications, 4th Edition, TMH New Delhi.
2. J. M. Senior: Optical Fiber Communication- Principles and Practices, 2nd Edition, Pearson Education.
3. G. P. Agarwal: Fiber Optic Communication Systems, 3rd Edition, Wiley India Pvt. Ltd.
4. J. C. Palais: Fiber Optics Communications,5th Edition, Pearson Education.
5. R.P. Khare: Fiber Optics and Optoelectronics, Oxford University Press.
6. A. Ghatak and K. Thyagrajan: Fiber Optics and Lasers, Macmillan India Ltd.
7. S. C. Gupta: Optoelectronic Devices and Systems, PHI Learning.
8. Sterling: Introduction to Fiber Optics, Cengage Learning.

List of Experiments:

1. Launching of light into the optical fiber and calculate the numerical aperture and V-number.
2. Observing Holograms and their study.
3. Optic version Mach-Zehnder interferometer.
4. Measurement of attenuation loss in an optical fiber.
5. Diffraction using gratings.
6. Construction of Michelson interferometer.
7. Setting up a fiber optic analog link and study of PAM.
8. Setting up a fiber optic digital link and study of TDM and Manchester coding.
9. Measurement of various misalignment losses in an optical fiber.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand basics of optical fibers
CO2	Knowledge of various light sources
CO3	Describe various detectors and other theoretical aspects of fibers
CO4	Illustrate various optical receivers
CO5	Elaborate optical technologies

JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
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COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B. Tech. VIII SEM EC	ADVANCE COMMUNICATION SYSTEMS	EC802	3	-	2	Maximum Marks – 70 Minimum Marks – 22 Duration – 3 Hours

Module-I

Carrier and Symbol Synchronization: Signal parameter estimation, The likelihood function, Carrier recovery and symbol synchronization in signal demodulation, Carrier phase estimation, Maximum likelihood carrier phase estimation, The phase locked loop, Effect of additive noise in phase estimation, Decision directed loops, Symbol timing estimation, Maximum likelihood timing estimation, Non-decision directed timing estimation, Joint estimation of carrier phase and symbol timing.

Module-II

Multicarrier Modulation: Data transmission using multiple carriers, Multicarrier modulation with overlapping subchannels, Mitigation of subcarrier fading, Coding with interleaving over time and frequency, Frequency equalization, Precoding, Adaptive loading, Discrete implementation of multicarrier, The cyclic prefix, Challenges in multicarrier systems, Peak to average Power ratio, Frequency and timing offset.

Module-III

Multiuser Communications: Introduction to multiple access techniques, Capacity of multiple access methods, Code division multiple access, CDMA signal and channel models, The optimum receiver, Suboptimum receivers, Performance characteristics of Detectors, Random access methods, ALOHA systems and protocols, Carrier sense systems and protocols.

Module-IV

Orthogonal Frequency Division Multiplexing Systems: Digital-signal-processing-centric implementation of OFDM, Matrix representation of OFDM, Vector coding, PSD of OFDM signal, PAR reduction strategies. Application of WCDMA and OFDM.

Module–V

Cognitive Networks: Definition, Requirements, Cognitive radio, Cross-layer design, Cognitive process, Cognitive network design.

References:

1. J. G. Proakis: Digital Communications, McGraw Hills.
2. A. Goldsmith: Wireless Communications, Cambridge University Press.
3. U. Madhow: Fundamentals of Digital Communication, Cambridge University Press.
4. H. Arslan: Cognitive Radio, Software Defined Radio,and Adaptive Wireless Systems, Springer

Course Outcomes:
Upon successful completion of course students will be able to:

CO1	Basic study of carrier and symbol synchronization
CO2	Knowledge of multicarrier modulation
CO3	Analyze various access methods
CO4	Discuss various OFDM techniques
CO5	Illustrate cognitive radio

List of practical:

1. Write a program to carrier recovery and symbol synchronization in non-coherent FSK demodulation.

2. Implement a multicarrier modulation system in MATLAB and show the advantages of precoding through the simulation results.

3. Implement two PAPR reduction techniques in MATLAB.

4. Implement the optimum receiver for CDMA system.

5. Study the performance characteristics for a CDMA system using MATLAB.

6. Implement the basic OFDM system in MATLAB.

7. Simulate the systems showing the methods a secondary user senses a channel in cognitive radio environment.

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COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B. Tech. VIII SEM	Nano Electronics	EC803A	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Module-I: Introduction Nanoscale technology: Consequences of the nanoscale for technology and society. Molecular building blocks for nanostructure systems, Nano-scale 1D to 3D structures, Band structure and density of states at low dimensional structure. Size dependent properties (Electrical, mechanical, optical, thermal etc).top down and bottom up technique, lithographic, nanolithographic and nonlithographictechniques:pulsed laser deposition,plasma arc discharge, e-beam sputtering, ball milling, solgel, electrodeposition, chemical vapour deposition.

Module-II : Characterization technique Scanning probe microscopy: (Principle, construction and working;) Scanning tunneling microscope, Atomic force microscope, scanning electron microscope, Transmission electron microscope, Carbon materials :Allotropes of carbon, Structure of Carbon Nanotubes, types of CNTs-, Electronic properties of CNTs, Band structure of Graphene,Band structure of SWNT from grapbene ,electron transport properties ofSWNTs ,

Module-III:Introduction to magnetism and superconductivity Basic magnetic phenomena: paramagnetism, ferromagnetism, ferrimagnetism, anti-ferromagnetism;nano-magnetism; giant and colossal magnetoresistance; ferrofluids. Basic superconductivity phenomena; flux quantization and Josephsoneffects.

Module-IV: Fundamental of nanoelectronics Charging of quantum dots, Coulomb blockade, Quantum mechanical treatment of quantum wells, wires and dots, Widening of bandgap in quantum dots, Strong and weak confinement, spin field effect transistor. single electron transistors, other SET and FET structure.

Module-V: Silicon MOSFETs Silicon MOSFET: fundamental of MOSFET devices, scaling rules, silicon dioxide based gate dielectrics, metal gates , junction and contacts, advanced MOSFET concepts

References:

1.G. W. Hanson: Fundamentals of Nanoelectronics, Pearson Education.
2. K. K. Chattopadhyay and A. N. Banerjee: Introduction to Nanoscience and Nanotechnology, PHI Learning.
3. John H. Davis: Physics of low dimension semiconductor, Cambridge Press.
4.KTu, JW Mayer, LC Feldman, "Electronic Thin Film Science", Macmillan, New York, 1992.
5. Z Cui , "Mico-Nanofabrication", Higher Education press, Springer, 2005.
6.Brian Cantor, "Novel Nanocrystalline Alloys and Magnetic Nanomaterials," Institute of Physics Publications, 2005.

7. S.Chikazumi and S.H. Charap," Physics of Magnetism", Springer-verlag berlin Heideberg, 2005
8.CaoGuozhong, "Nanostructures and Nanomaterials - Synthesis, Properties and Applications", Imperial College Press, 2004.
9. SadamichiMaekawa, "Concepts in Spintronics", Oxford University Press, 2006.

Course Outcomes:
Upon successful completion of course students will be able to:

CO1	Understand Nanoscale technologies
CO2	Describe various characterization techniques
CO3	Illustrate magnetism and superconductivity
CO4	Knowledge about fundamental of nano electronics
CO5	Elaborate silicon MOSFET

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COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B.Tech. VIII SEM	SOC Design	EC803B	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

System On Chip Design

Module I

System Level Design: System level design-tools & methodologies for system level design, system level space & modeling languages, SOC block based design & IP assembly, performance evaluation methods for multiprocessor SOC design.

Module II

Power Management and Synthesizing: System level power management, processor modeling & design tools, embedded software modeling & design using performance metrics to select microprocessor for IC design, parallelizing high-level synthesize, a code transformation approach to high level synthesize.

Module III

Micro-Architecture Design and Power Optimization: Micro-architecture design, cycle accurate system-level modeling, performance evaluation, micro architectural power estimation optimization, design planning.

Module IV

Software Design Verification: Logical verification, design & verification languages, digital simulation, using transactional, level models in an SOC design, assertion based verification.

Module V

Hardware Design Verification: Hardware acceleration & emulation, formal property verification, TEST, DFT, ATPG, Analog & mixed signal test.

TEXT BOOKS:

1. Louis Scheffer Luciano Lavagna and Grant Martin, "EDA for IC system verification and testing", CRC, 2006.
2. Wayone Wolf, " Modern VLSI design: SOC design".
3. Prakash Rashnikar, Peter Paterson, Lenna Singh "System-On-A-Chip verification methodology & techniques", Kluwer Academic Publishers.
4. Alberto Sangiovanni Vincentelli, "Surviving the SOC revolution: A guide to platform based design", Kluwer Academic Publishers.

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	To understand the basic concepts of SOC design
CO2	To summarize and explain the performance evaluation methods
CO3	To classify and understand the power management process and modeling design tools
CO4	To understand and study the micro-architecture design and modeling, software and hardware design verification
CO5	To develop designing concept of chips

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Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B.Tech. VIII SEM	Sensor Technology	EC803C	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Course structure

Module I- Sensors Fundamentals and Characteristics

Sensors, Signals and Systems; Sensor Classification; Units of Measurements; Sensor Characteristics

Module II-Physical Principles of Sensing

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements

Module III- Interface Electronic Circuits

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

Module IV- Sensors in Different Application Area

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors

Module V- Sensor Materials and Technologies

Materials, Surface Processing, Nano-Technology

Reference Books:

1. J. Fraden, Handbook of Modern Sensors:Physical, Designs, and Applications, AIP Press, Springer
2. D. Patranabis, Sensors and Transducers, PHI Publication, New Delhi
3. Mechatronics- Ganesh S. Hegde, Published by University Science Press (An imprint of Laxmi Publication Private Limited).

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understand sensor fundamentals
CO2	Describe physical principle of sensing
CO3	Interface various Electronic circuits
CO4	Discuss sensors in different application area
CO5	Knowledge of sensor material and technologies

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COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B.Tech. VIII SEM	Economics & Social Issues	EC804A	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Module –I Indian Economy on the eve of independence, British Rule and its impact on economy, Population growth its pattern, genders, rural urban literacy, Poverty and inequality agriculture and its productivity Green Revolution, Industrial economy pattern, small scale industries.

Module –II Micro economics, Theory of consumer behavior, Law of diminishing utility, demand and supply, Demand curve, elasticity of demand, Theory of production, Theory of cast.

Module –III National income, Measurement of national income, Measurement of cost of living, Consumption function, investment function, Economics fluctuations GDP,GVP.

Module –IV Concept of public and private goods public budget, optimum budget, plan budget, budget procedure of India, Taxes in India.

Module – V Indian economy policy, population policy anti povertyprogrammes, NRECA Risht to employment, MSME, growth, structure EXIM policies.

Reference Books:

1. Mishra &Puri Indian Economy
2. Rana&Verma Macro economics
3. NavendraJadhav, Monetary Policy
4. J. Ray Chellaih, Trends and Issues in Indian Finance

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Understanding Indian Economy since independence
CO2	General information about micro Economics, Demand supply Losses
CO3	Compressive Knowledge about GDP and GNP, consumption
CO4	Compressive study of private public systems functioning and taxation systems
CO5	Knowledge about polices of Indian Economy and MSME

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Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B.Tech. VIII SEM	Internet of Things	EC804B	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Module 1: **IoT Introduction and Fundamentals**: Deciphering the term IoT, Applications where IoT can be deployed, Benefits/challenges of deploying an IoT, IoT components: Sensors, front-end electronics (amplifiers, filtering, digitization), digital signal processing, data transmission, choice of channel (wired/wireless), back-end data analysis. Understanding packaging and power constraints for IoT implementation

Module 2: Signals, Sensors, Actuators, Interfaces: Sensors: types, signal types, shape and strength, Sensor non-idealities: Sensitivity and offset drift, noise, minimum detectable signal, nonlinearity, Read-out circuits: Instrumentation-amplifier, SNR definition, noise-bandwidth-power trade off, Circuit component mismatch and mitigation techniques (calibration, chopping, auto zeroing etc.), Power/energy considerations, Basic signal processing (filtering, quantization, computation, storage),

Module 3: Networking in IoT: Review of Communication Networks, Challenges in Networking of IoT Nodes, range, bandwidth, Machine-to-Machine (M2M) and IoT Technology Fundamentals, Medium Access Control(MAC) Protocols for M2M Communications, Standards for the IoT, Basics of 5G Cellular Networks and 5G IoT Communications, Low-Power Wide Area Networks (LPWAN), Wireless communication for IoT: channel models, power budgets, data rates, IoT Security and Privacy, MQTT Protocol, Publisher and Subscriber Model

Module 4: Cloud Computing in IoT
Cloud computing platform (open source) and local setup of such environment, embedded software relevant to microcontroller and IoT platforms (enterprise or consumer), user interfaces

Module 5: Data Analysis for IoT applications
Statistics relevant to large data, linear regression, Basics of clustering, classification

Course Outcomes:
Upon successful completion of course students will be able to:

CO1	Understand the fundamentals of Internet of things
CO2	Knowledge of interfacing of signal, sensors and actuators in Internet of Things
CO3	Interpret networking in Internet of things
CO4	Implement on Cloud computing in Internet of things
CO5	Analyze the data for various Internet of things applications

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COURSE CONTENTS w.e.f. July 2017-18 batch

Category of Course	Course Title	Course Code	Credits-4			Theory Papers
			L	T	P	
B.Tech. VIII SEM	Fuzzy and Neural Network	EC804C	3	-	-	Max. Marks-70 Min. Marks - 22 Duration-3 hours

Course structure

Module – I : Classical & Fuzzy Sets
Introduction to classical sets – properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

Module – II: Fuzzy Logic System Components
Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Module–III : Introduction to Neural Networks
Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application

Module - IV: Single and Multi Layer Feed Forward Neural Networks
Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications. Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP) Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

Module - V: Applications
Neural network applications: Process identification, control, fault diagnosis and load forecasting. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication
2. Neural Networks – James A Freeman and Davis Skapura, Pearson Education, 2002.
3. Neural Networks – Simon Hakins , Pearson Education
4. Neural Engineering by C.Eliasmith and CH.Anderson, PHI Neural Networks and Fuzzy Logic System by Bart Kosko, PHI Publications

Course Outcomes:

Upon successful completion of course students will be able to:

CO1	Introduction to Neural Network
CO2	Differentiate between single and multilayer feed forward neural network
CO3	Discuss classical and fuzzy sets
CO4	Knowledge of fuzzy logic system components
CO5	Illustrate various Neural network application

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Category of Course	Course Title	Course Code	Credits-4			Sessional
			L	T	P	
B. Tech. VIII SEM EC	Major Project	EC805			12	Max. Marks-50 Min. Marks - 25

The major project will be made on the basis of knowledge of subjects acquired during the the entire course of B E Degree. Major Project can be made in following broad areas

1. A complete hardware project
2. A complete software based simulation project in matlab/higher level languages
3. Project based on experiments carried out inlab.
4. Microprocessor and micro controller based software/hardware project
5. Theoretical project on new emerging technologies
6. Inter disciplinary project eg Biomedical electronics, mechatronics, nanotechnology etc

Project work is normally carried out in group students. Individual projects are not advised at UG level. The list of batches displayed along with guide name during sixth sem minor project and same Remains valid for major project.. Student have liberty to make smaller groups with the Permission of guide/ supervisor. Project report normally submitted 60 -70 single side print pages in a hard bind form including certificates and cover pages.

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Bachelor of Technology (B.Tech.) VIII Semester (Electrical Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	EE801	PCC	EHV AC & HVDC Transmission	70	20	10	30	20	150	3	-	2	4
2	EE802	PCC	Advanced Electrical Drives	70	20	10	30	20	150	3	-	2	4
3	EE803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	EE804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	EE805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
Total				**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	EE803A	Process Control
2	EE803B	SCADA System & Application
3	EE803C	Renewable & Non Conventional Energy Sources

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	EE804A	Digital Image Processing
2	EE804B	Power Quality
3	EE804C	Computer Networks

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

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Bachelor of Technology (Electrical Engineering) Semester: VIII

w.e.f. July 2017-18 batch

Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE801	EHV A.C. & D.C. TRANSMISSION	70	20	10	30	20	150	3	-	2	4

Course Outcomes

CO1 – To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
CO2 – To classify various compensators suited for various power system purposes.
CO3 – To familiarize the students with the HVDC converters and their control system.
CO4 –To analyse harmonics and design of filters.

EHV A.C. & D.C. TRANSMISSION

Module-I: Constitution of EHV A.C. and D.C. links, Kind of D.C. links, Limitations and Advantages of A.C. and D.C. transmission, Principal application of A.C. and D.C. transmission, Trends in EHV A.C. and D.C. transmission, Power handling capacity. Converter analysis, Graetz's circuit, firing angle control, overlapping.

Module –II: FACTS devices, basic types of controller, series controller, static synchronous series compensator (SSSC), thyristor-controlled series capacitor (TCSC), thyristor controlled series reactor (TCSR), shunt controller (STATCOM), static VAR compensator (SVC), series-series controller, combined series-shunt controller, unified power flow controller (UPFC), thyristor controlled phase shifting transformer (TCPST).

Module –III: Components of EHV D.C. system, converter circuits, rectifier and inverter valves, Reactive power requirements, harmonics generation, Adverse effects, Classification, Remedial measures to suppress, filters, Ground return. Converter faults & protection. harmonics misoperation, Commutation failure, Multi-terminal D.C. lines.

Module –IV: Control of EHV D.C. system desired features of control, control characteristics, Constant current control, Constant extinction angle control. Ignition Angle control. Parallel operation of HVAC & DC system. Problems & advantages.

Module –V: Travelling waves on transmission systems, their shape, Attenuation and distortion, effect of junction and termination on propagation of travelling waves. Over voltages in transmission system. Lightning, switching and temporary over voltages: Control of lighting and switching over voltages

Reference:

1. S. Rao,- "EHV AC & DC Transmission" Khanna pub.
2. Kimbark,-" HVDC Transmission" john willy & sons pub.
3. Arrillaga,- "HVDC Transmission"2nd Edition ,IEE londan pub.
4. Padiyar, -"HVDC Transmission" 1st Edition ,New age international pub.
5. T.K. Nagsarkar,M.S. Sukhiza, -"Power System Analysis", Oxford University
6. Narain.G. Hingorani, l. Gyugyi-"Undustanding of FACTS concept and technology", John Wiley & sons pub.
7. P.Kundur- "H.V.D.C. Transmission" McGraw Hill Pub.

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Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE802	Advanced Electric Drives	70	20	10	30	20	150	3	-	2	4

Course Outcomes

CO1 – Understand the operation of power electronic converters and their control strategies.
CO2 – To Develop controllers for open loop and closed-loop operation of DC motor drives.
CO3 – Develop high performance AC motor drives using the principles of Scalar control, vector and Direct Torque Control.
CO4 – Implement control schemes for AC, DC and special motor drives.

ADVANCED ELECTRIC DRIVES

Module-I : Power Converters for AC and DC drives
Converters, inverters, chopper and cycloconverter operation. PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive.

Module-II: DC Drives
Converter and chopper fed DC drive, Starting, speed control and breaking, four quadrant operation, and High power application

Module-III: Induction motor drives
Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC), PLC based Induction motor drives.

Module-IV: Synchronous motor drives
Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives, PLC based Induction motor drives.

Module-V: Special Drives
Evolution of switched reluctance motors, various topologies for SRM drives, Closed loop speed and torque control of SRM. Servo drives & stepper motor- AC & DC Servomotor, Stepper motor, Control techniques. PMBLDC and PMSM drive configuration, Speed and torque control in PMBLDC and PMSM.

Reference Books:

1. B.K. Bose, Power Electronics & AC drive prentice Hall.
2. Ned Mohan, T.M. Undeland, W.P. Robbins, Power Electronics-Converters, Applications and design", John Wiley & Sons.
3. J.M.D. Murphy, F.O. Turnbull, "Power Electronic Control of AC motors", Pergamon Press.
4. P.C. Sen, D.C. drive, Pergamon Press
5. Dubey G.K. "Power semi Conductor controller drives, Prentice Hall.
6. Vedam Subramanyam, "Electrical Drives".
7. T.J.E. Miller, Switched Reluctance & P.M. B.L. DC motor, Pergamon Press
8. P.V. Rao, "Power semiconductor Drives", BS Publications.

List of Experiments:

1. To perform harmonics analysis of conventional and special machines using power analyzer.
2. To design a control circuit and perform its operation for open loop & close loop speed control analysis of a separately excited DC motor using Real Time Controller.
3. To design a control circuit and perform its operation for open loop & close loop speed control analysis of a single phase Induction motor using Real Time Controller.
4. To design a control circuit and perform its operation for open loop & close loop speed control analysis of a three phase Induction motor using Real Time Controller.
5. To design a control circuit and perform its operation for open loop & close loop speed control analysis of a Permanent Magnet Brush Less DC motor (PMBLDC) using Real Time Controller.
6. Virtual study of hardware and software used in PLC.
7. Virtual study for the implementation of Logic Gates, On/Off - Delay Timer and UP/Down Counter.
8. Virtual study for the implementation of DOL and Star Delta Starter for AC Motors.
9. Virtual study for the implementation of PID controller to control the speed of AC/DC Drives.
10. Design a control circuit and perform its operation to analyze the performance of a three phase Induction motor using PLC Controller.

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Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE803A	Process Control	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – Identify different process dynamics in process industries and their control schemes.
CO2 – Analyze and Design different types of mechanical, optical sensor and actuators.
CO3 –Differentiate process controller's their stability and tuning.

PROCESS CONTROL

Module I: Introduction to Process Control
Dynamic behaviour of first order, second order and higher order process systems, Characteristics of process systems with large time constants, Batch and Continuous processes.

Module II: Thermal Sensors & Actuators
Thermal Sensors, Thermistors, Thermocouples design, Characteristics and operating principles, Mechanical Sensors, Strain Sensor, Motion Sensor, Pressure Sensor design, Characteristics and operating principles, Different types of Actuators

Module III: Optical Sensors & Control
Optical Sensors, Fundamentals of EM Radiation, Photodetector Characteristics and operating principles, Pyrometry, Application of Optical Sensors, and Control Elements

Module IV: Process Controllers
Automatic controllers, Concept of feedback control, Controller Principles, Analog and Digital Controllers design, Generation of control action in electronic and pneumatic controllers. Introduction to Supervisory Control

Module V: Controller's Configuration, Stability and Tuning
Control Loop Characteristics of Controllers, Single and Cascade control configuration, Multivariable controls, Quality of Control, Stability and Process loop tuning-transient response, Ziegler-Nichols, Frequency Response method

References:

1. Dale Patrick, Stephen Fardo, "Industrial Process Control System".
2. Shinskey F.G., "Process Control System", III Ed., McGraw Hill.
3. Krishnaswamy K. "Process Control" , New Age International Publication
4. Johnson Curtis D. "Process Control Instrumentation Technology",PHI
5. Smith C.A. & A.B. Corripio, "Principle & Practiced Automatic Process Control", J. Willey.
6. Rao M & S.Qiv, "Process Control Engg.", Gorden & Breach.

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Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE803B	SCADA Systems & Applications	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – Understanding of Supervisory control & Data acquisition.
CO2 – Design of SCADA systems with establishment of communication protocols.
CO3 – Application of the SCADA to utilities for their operation & control.

SCADA SYSTEMS & APPLICATIONS

Module I: Introduction to SCADA and PLC:SCADA: Data acquisition system, evaluation of SCADA, communication technologies, monitoring and supervisory functions. PLC: Block diagram, programming languages, Ladder diagram, Functional Block diagram, Applications, Interfacing of PLC with SCADA.

Module II: SCADA system components: Schemes, Remote Terminal Unit, Intelligent Electronic Devices, Communication Network, SCADA server.

Module III: SCADA Architecture-Various SCADA Architectures, advantages and disadvantages of each system, single unified standard architecture IEC 61850 SCADA / HMI Systems.

Module IV: SCADA Communication-Various industrial communication technologies-wired and wireless methods and fiber optics, open standard communication protocols.

Module V: Operation and control of interconnected power system-Automatic substation control, SCADA configuration, Energy management system, system operating states, system security, state estimation.

SCADA applications Utility applications, transmission and distribution sector operation, monitoring analysis and improvement. Industries oil gas and water. Case studies, implementation, simulation exercises.

Reference Books:

1. Stuart A Boyer: SCADA supervisory control and data acquisition.
2. Gordan Clark, Deem Reynders, Practical Modem SCADA Protocols.
3. Sunil S. Rao, Switchgear and Protections, Khanna Publication.

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Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE803C	Renewable & Non Conventional Energy Sources	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – Understand the need of energy conversion and the various methods of energy storage.
CO2 – Explain the field applications of renewable energy sources.
CO3 – Illustrate the concepts of Direct Energy Conversion systems & their applications.

RENEWABLE & NON CONVENTIONAL ENERGY SOURCES

Module – I: Renewable Energy Systems
Energy Sources, Comparison of Conventional and non-conventional, renewable and non-renewable sources. Statistics of world resources and data on different sources globally and in Indian context. Significance of renewable sources and their exploitation. Energy planning, Energy efficiency and management.

Module – II: Wind Energy System
Wind Energy, Wind Mills, Grid connected systems. System configuration, working principles, limitations. Effects of wind speed and grid conditions. Grid independent systems - wind-battery, wind diesel, wind hydro biomass etc. wind operated pumps, controller for energy balance.Small Hydro System Grid connected system, system configuration, working principles, limitations. Effect of hydro potential and grid condition. Synchronous versus Induction Generator for stand alone systems. Use of electronic load controllers and self excited induction generators.Wave Energy System: System configuration: grid connected and hybrid systems.

Module – III: Solar Radiation
Extraterrestrial solar radiation, terrestrial solar radiation, Solar thermal conversion, **Solar Photo tonic System** Solar cell, Solar cell materials, efficiency, Characteristics of PV panels under varying insulation. PV operated lighting and water pumps, characteristics of motors and pumps connected to PV panels.
Biomass Energy System: System configuration, Biomass engine driven generators, feeding loads in stand-alone or hybrid modes, Biomass energy and their characteristics.

Module – IV: Energy from oceans, Ocean temperature difference, Principles of OTEC, plant operations,
Geothermal Energy, Electric Energy from gaseous cells, Magneto-hydro generated energy, Non hazardous energy from nuclear wastes, Possibilities of other modern non-conventional energy sources.

Module – V: Electric Energy Conservation

Energy efficient motors and other equipment. Energy saving in Power Electronic controlled drives. Electricity saving in pumps, air-conditioning, power plants, process industries, illumination etc. Methods of Energy Audit.

Measurements systems; efficiency measurements. energy regulation, typical case studies, various measuring devices analog and digital, use of thyristors.

References:

1. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.
2. El-Wakil, Power Plant Technology, McGraw Hill.
3. Rai G D, Non-conventional Energy Resources, Khanna.
4. F Howard E. Jordan, "Energy-Efficient Electric Motor & their Application-II", Plenum Press, New York, USA.
5. Anna Mani, "Wind Energy Resource Survey **in** India-III", Allied Publishers Ltd., New Delhi,
6. S.P. Sukhatme: Solar Energy, TMH-4e,
7. Dr. A. Ramachandran, Prof B.V Sreekantan & M F.C. Kohli etc, "TERI Energy Data Directory & Year book 1994-95", Teri Tata Energy Research Institute, New Delhi

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Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE804A	Digital Image Processing	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – Understand the basics of digital image processing.
CO2 – Operate on images using the techniques of smoothing, sharpening and enhancement.
CO3 – Implement and Analyze the Images using various algorithms.
CO4 – design adaptive algorithm suitable for image restoration, segmentation, compression, recognition etc

DIGITAL IMAGE PROCESSING

Module –I : Digital Image Fundamentals: Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT

Module -II : Image Enhancement: Spatial Domain: Gray level transformations – Histogram processing , Basics of Spatial Filtering,Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters , Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

Module -III: Image Restoration: Image Restoration , degradation model, Properties, Noise models , Mean Filters , Order Statistics , Adaptive filters , Band reject Filters, Band pass Filters , Notch Filters , Optimum Notch Filtering , Inverse Filtering , Wiener filtering.

Module -IV: Image Segmemtation: Edge detection, Edge linking via Hough transform , Thresholding , Region based segmentation , Region growing , Region splitting and merging , Morphological processing, erosion and dilation, Segmentation by morphological watersheds , basic concepts , Dam construction , Watershed segmentation algorithm.

Module -V: Image Compression and Recognition: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors , Topological feature, Texture , Patterns and Pattern classes , Recognition based on matching.

Text books:

1.R.C.Gonzalez and Richard E Woods, "Digital Image Processing", Fourth edition, Pearson Education.

2. Anil.K.Jain – Fundamentals of Digital Image Processing- Pearson Education-2003.

Reference Book:

B.Chanda and D. Dutta Majumdar, "Digital Image Processing and Analysis", Second edition,PHI

Jabalpur Engineering College, Jabalpur

(AICTE Model Curriculum based scheme)

Bachelor of Technology (Electrical Engineering) Semester: VIII

w.e.f. July 2017-18 batch

Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE804B	Power Quality	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – To introduce to students the term and definition of power quality disturbances, and their causes, detrimental effects and solutions.
CO2 – Understand the causes of power quality problems and relate them to equipment.
CO3 –To introduce the harmonic sources, passive filters, active filters and standards.
CO4 – To prepare students to know the power quality monitoring method, equipments and develop the ability to analyze the measured data.

POWER QUALITY

Module –I: Introduction, power quality -voltage quality, power quality evaluations procedures term and definition: general classes of power quality problem, causes & effect of power quality disturbances.

Module –II: Voltage sags and interruption: sources of sags and interruption, estimating voltages sag performance, fundamental principles of of protection, monitoring sags.

Module –III: Transients over voltages: sources of transient over voltages, principles of over voltages protection, utility capacitor switching transients, fundamentals of harmonics and harmonics distortion, harmonics sources from commercial load and from industrial loads.

Module –IV: Applied harmonics : harmonics distortion evalutions, principles for controlling harmonics, harmonics studies devices for controlling harmonic distortion, filters, passive input filter standards of harmonics.

Module –V: Electro-magnetic compatibility, constant frequency control, constant tolerance band control, variable tolerance band control, discontinuous current control.

Reference Books:

1. Power Quality- by R.C. Duggan
2. Power System harmonics –by A.J. Arrillga
3. Power electronic converter harmonics –by Derek A. Paice

Jabalpur Engineering College, Jabalpur

(AICTE Model Curriculum based scheme)

Bachelor of Technology (Electrical Engineering) Semester: VIII

w.e.f. July 2017-18 batch

Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE804C	Computer Networks	70	20	10	-	-	100	3	-	-	3

Course Outcome

CO1 – Understand the principles and concepts on computer networks.
CO2 – Understand general-purpose computer networks.
CO3 – Master the computer network applications.
CO4 – Master the knowledge on designing and building a complete system.

COMPUTER NETWORKS

Module – I: INTRODUCTION: Network applications, network hardware, network software, reference models: OSI, TCP/IP, Internet, Connection oriented network - X.25, frame relay.
THE PHYSICAL LAYER: Theoretical basis for communication, guided transmission media, wireless transmission, the public switched telephone networks, mobile telephone system.

Module – II: THE DATA LINK LAYER: Design issues, error detection and correction, elementary data link protocols, sliding window protocols, example data link protocols - HDLC, the data link layer in the internet.
THE MEDIUM ACCESS SUBLAYER: Channel allocations problem, multiple access protocols, Ethernet, Data Link Layer switching, Wireless LAN, Broadband Wireless, Bluetooth

Module - III : THE NETWORK LAYER: Network layer design issues, routing algorithms, Congestion control algorithms, Internetworking, the network layer in the internet (IPv4 and IPv6), Quality of Service.

Module – IV: THE TRANSPORT LAYER: Transport service, elements of transport protocol, Simple Transport Protocol, Internet transport layer protocols: UDP and TCP.

Module – V: THE APPLICATION LAYER: Domain name system, electronic mail, World Wide Web: architectural overview, dynamic web document and http.
APPLICATION LAYER PROTOCOLS: Simple Network Management Protocol, File Transfer Protocol, Simple Mail Transfer Protocol, Telnet.

TEXT BOOKS:

1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.

REFERENCE BOOKS:

1. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
2. 2. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India.

Jabalpur Engineering College, Jabalpur

(AICTE Model Curriculum based scheme)

Bachelor of Technology (Electrical Engineering) Semester: VIII

w.e.f. July 2017-18 batch

Subject Code	Subject Name & Title	Maximum Marks allotted					Total Marks	Hours / Week			Total Credits
		Theory			Practical						
		End Sem	Mid Sem	Quiz, Assignments	End Sem	Lab Work		L	T	P	
EE805	Project – II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6

PROJECT – II (TESTING & IMPLEMENTATION)

The objectives of the course 'Project – II (Testing & Implementation)' are

- To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
- To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
- To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
- To adapt students for latest developments and to handle independently new situations.
- To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write-up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis, market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration.

The faculty and student should work according to following schedule:

i) Each student undertakes substantial project in an approved area of the subject and supervised by a member of staff.

ii) The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.

iii) At all the steps of the project, students must submit a written report of the same.

Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Industrial & Production Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	IP801	PCC	Computer Integrated Manufacturing	70	20	10	30	20	150	3	-	2	4
2	IP802	PCC	Computer Aided Design	70	20	10	30	20	150	3	-	2	4
3	IP803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	IP804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	IP805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	IP803A	Entrepreneurship & Management Concept
2	IP803B	Industrial Psychology & Human Behaviour
3	IP803C	Finite Element Methods

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	IP804A	Management Information System
2	IP804B	Work Design and Ergonomics
3	IP804C	Concurrent Product Design

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.Tech. Industrial &Production Engineering (VIII-Semester) AICTE

Credits: 4	**IP801**	**Computer Integrated Manufacturing**	**L: 3, T:0,P:2**

Course objectives
1.To enable graduate to concept of concept of computer integrated manufacturing.
2. To provide the knowledge of CAPP.
3 To aware the students about the various information computer aided " manufacturing.
4- To provide the knowledge automated material handling.
5. To provide the knowledge of Group technology.

Module-I

Introduction to CIM: Objectives of CIM, Enterprise wide Integration of CIM Information requirements of manufacturing organizations, Scope of Computer Integrated Manufacturing Business forecasting and aggregate production plan, Production Activity Control (PAC), Manufacturing as a system, Production processes on volume-variety axes, Importance of batch and job shop production, CIM definition and CIM wheel, Evolution and benefits of CIM, Automation, Types of Automation, Advantages of Automation.

Module-II

Computer Aided Process Planning (CAPP): Introduction to CAPP, Objectives to CAPP, Introduction to Process Planning, Approaches to Process Planning, Manual Experience-based Process Planning, Computer Aided Process Planning, Approaches to Computer Aided Process Planning, Variant Process Planning, Advantages and Disadvantages, Generative Process Planning, Advantages and Disadvantages, Knowledge-based Process Planning, Feature Recognition in Computer Aided Process Planning, Approaches to Part Feature Recognition, Recent Trends in Computer Aided Process Planning.

Module-III

Computer Aided Manufacturing: Introduction to CAM, Numerical Control system, Suitability of NC technology, Need of NC system, Features and classification of NC system, Computer Numerical Control, Features of CNC , Direct Numerical Control, NC words used in part program, Manual and Computer Aided Part Program, APT Programming.

Module-IV

Automated Material Handling and Storage: Introduction and Objectives of Automated Material Handling, Principles of Automated Material Handling, Factors considered in selection of automated material handling equipments, Material handling Equipment, Conveyor systems, Cranes and Hoists, Industrial Trucks, Monorail, Automated Guided Vehicle, Automated storage and Retrival System.

Module-V

Group Technology: Importance of batch and job shop production, Merits of converting zigzag process layout flow to smooth flow in cellular layout, Production flow Analysis and clustering methods, Concept of part families and coding, Optiz, MIClass and Dclass coding, FMS.

Text Books

1. Roa. P.N. CAD/CAM, Tata McGraw Hill Publishing Co.
2. S.Kant Vajpay, Principles of CIM, PHI Publishing Co.
3. Radhakrishan P.CAD/CAM/CIM, New age Publishing Co.

References

1. Zeid A. CAD/CAM, Tata McGraw Hill Publishing Co.
2. Roa. CAD/CAM, Tata McGraw Hill Publishing Co.

Course Outcomes:

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

CO1	understand the uses of computer integrated manufacturing.
CO2	Understand functional concept of CApp
CO3	Learn the function and issue of computer integrated manufacturing.
CO4	Understand about emerging treads in Group technology.
CO5	Understand Automated Material Handling,

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

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.Tech. Industrial &Production Engineering (VIII-Semester) AICTE

Credits: 4	IP802	Computer Aided Design	L: 3, T:0,P:2

Course Objectives
1 To provides the knowledge and concept of Computer aided design.
2 To enable graduates to conceptualize the importance Computer aided drafting .
3 To provide the knowledge of Geometric modeling.
4 To provides the knowledge of engineering optimizatron

Module-I
Fundamental of CAD, Automation and CAD, Product Cycle & CAD, Introduction to computer Hardware, Design of workstation, Graphics terminal. Operator input & output devices, CPU and Secondary storage. Introduction to computer software and their application.

Module-II
Computer Aided Drafting - Creating Drawing: Various drawing commands: Line, Pline, Ellipse, Circle, Arc, Hatch, Text, Dimension, Limits, Scale, Grid, Layers, Fill, Snap, Trace, Units, Ortho. Editing Drawing: Various editing commands: Move, Erase, Copy, Zoom, Pan, View, Chamfer, Break, Explode, Extend, Trim, Help, Rotate, Mirror etc.
Other Utilities: Block, Array, Save, Quit, Plot Advanced Features of Auto- CAD: UCS, 3D-line, 3D-Objects, DXF & DXB files.

Module–III
Geometric modeling- introduction, wire frame model, data structures for computer graphics, Review of vector algebra, lines, circle, ellipses, parabolas, hyperbolas, conics, parametric representation of synthetic curves: hermite cubic splines, bezier curve, b spline curves, rational curves. Curves: Algebraic and geometric forms, tangents and normal, blending functions

Module–IV
2D and 3D geometric transformations, homogenous coordinates, translation, rotation, scaling, reflection, shear, and transformations between coordinate systems, affine transformations.3-D geometric transformations, 3-D viewing operations and graphics projections, visual realism, hidden line removal, shading and color models.

Module–V
Methods to solve engineering problems- analytical, numerical, experimental, their merits and comparison, discretization into smaller elements and effect of size/ shape on accuracy, importance of meshing, boundary conditions, Computer Aided Engineering (CAE) and design, chain-bumping-stages vs concurrent-collaborative design cycles, computer as enabler for concurrent design and Finite Element Method (FEM), degree of freedom (DOF), mechanical systems with mass, damper and spring, stiffness constant K for tensile, bending and torsion; Practical applications of FEA in new design, optimization/ cost-cutting and failure analysis.

Reference Books:

1. Inside Autocad By Ranker
2. CAD/CAM – principle and application By P N Rao, TMH
3. CAD/CAM – Zeid Ibrahim,TMH
4. Practical Finite Element Analysis By Gokhle Nitin
5. Finite Element Analysis, Theory and programming By Krishnamoorthy,TMH

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

CO1	To understand the concept of importance of Computer aided design..
CO2	To understand Geometric modeling.
CO3	To understand Computer aided drafting.
CO4	To solve engineering optimization problems.
CO5	Understand 2D and 3D geometric transformations.

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

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.Tech. Industrial &Production Engineering (VIII-Semester) AICTE

Credits: 4	**IP803A**	**Entrepreneurship and management concept**	**L: 3, T:0,P:0**

Course Objectives

1. To provides the knowledge and concept of management and Entrepreneurship.
2. To enable graduates to conceptualizethe importance of marketing and its need.
3. To provide the knowledge of finance system and concept of intellectual property system.

Module-I

Management: Importance, definition and functions; schools of theories, BCG matrix, SWOT analysis, steps in decision making, structured and unstructured decision; dimensions of organizations, departmentalization, spam and line of control, technology and Minzberg organization typology, line and staff organization, business process reengineering and process of change management, leader & manager, leadership grid, Maslow's need hierarchy and Herzberg two factor theory, team work and stress management, , HR planning placement and training

Module-II

Marketing: Importance, definition, core concepts of need want and demand, exchange & relationships, product value, cost and satisfaction (goods and services) marketing environment; selling, marketing and societal marketing concepts; four P's, product, price, placement, promotion; consumer, business and industrial market, market targeting, advertising, publicity, CRM and market research.

Module-III

Finance: Nature and scope, forms of business ownerships, balance sheet, profit and loss account, fund flow and cash flow statements, breakeven point (BEP) and financial ratio analysis, pay-back period, NPV and capital budgeting.

Module-IV

Intellectual Property System: Introduction, Definition of Intellectual property, Concept of Intellectual Property, Different Types of IP, Intellectual Property Rights (IPR), Benefits of securing IPRs;, Rationale behind Intellectual Property, Enforcement of IPRs, Patent Law in India, Interpretations and Implementations, Copyrights and related rights, Trademarks, Geographical indications, Industrial designs, Trade secrets and layout of Integrated circuits , Indian Legislations for the protection of various types of Intellectual Properties; TRIPs and various provisions in TRIPs Agreement.

Module-V

Entrepreneurship : Definition and concepts, characteristics, comparison with manager, Becoming an Entrepreneur, Need for Entrepreneurship, Benefits of Self-Employment, Who is an Entrepreneur?, Sensing Opportunities- Sources of Idea, Creating Efforts, SWOT Analysis, Entrepreneur and Economy, classification and function of entrepreneurs, sociological and economic theories of entrepreneurship, entrepreneur traits and behavior, roles in economic growth.

References:

1- Daft R; The new era of management; Cengage.
2- Bhat Anil, Arya kumar; Management: Principles ,Processes and Practices; Oxford higher edu.
3- Davis & Olson; Management Information System; TMH.
4- Steven Alter; Information systems, Pearson, www.stevenalter.com
5- Kotler P; Marketing management;
6- Khan, Jain; Financial Management;
7- ILO; Work study; ILO.
8- Mohanty SK; Fundamental of Entrepreneurship; PHI.

Course Outcomes:

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

CO1	To understand the concept and importance of management and Entrepreneurship.
CO2	To understand market research
CO3	To understand intellectual properfy system and their types.
CO4	To make balance sheet and find break even point.
CO5	To understand entrepreneur traits and behavior.

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

INDUSTRIAL PSYCHOLOGY AND HUMAN BEHAVIOUR
IP803B

Module-I

Industrial Psychology: Basic concepts, Role and Application, Discipline, Fatigue, Accidents, Labour welfare, Supervision.

Module–II

Maintenance of Human Resource : Health, Safety, Labour welfare, Welfare measures, Human Relations, Personnel audit, Industrial Safety, Safety efforts by government, Safety programs.

Module–III

Industrial Relations: Objective, Industrial unrest, Industrial peace, Parties in industrial relations, Organizational conflicts, Industrial disputes and their settlement, Impact of Conflicts, Sources of conflicts, Labour policy, Worker's grievances, Suggestion system

Module-IV

Human Behaviour: Attitudes and Job satisfaction, Emotions and Moods, Personality and values, Perception and Decision making.

Module-V

Group Behaviour: Foundation of group behavior, Understanding work teams, Communication, power and Politics, Conflicts and Negotiations

Reference Books:

1. Industrial Organisation and Engineering Economics – T.R. Banga and S.C. Sharma
2. Organisationl Behaviour – Stephen P. Robbins, Timathy A. Judge and Neharika Vohra
3. Organisationl Behaviour part-1 and Part-2 –John B. Miner

Course Outcomes:

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

CO1	understand Industrial Psychology
CO2	Understand Maintenance of Human Resource
CO3	Understand Industrial Relations
CO4	Understand about Human Behaviour
CO5	Understand and work teams.

IP803C – Finite Element Method

Module-I

GENERAL PROCEDURE OF FINITE ELEMENT METHOD

Basic concept of FEM, Engineering applications, Comparison of FEM with other methods of analysis, Discretization of the domain-Basic element shapes, discretization process, Interpolation polynomials, Selection of the order of the interpolation polynomial, Convergence requirements, Linear interpolation

Module-II

polynomials in terms of global and local coordinates, Formulation of element characteristic matrices and vectors-Direct approach, variational approach, weighted residual approach, Assembly of element matrices and vectors and derivation of system equations together with their solution.

Module-III

HIGH-- ORDER AND ISO-PARAMETRIC ELEMENT FORMULATIONS

Introduction, Higher order one-dimensional element, Higher order elements in terms of natural coordinates and in terms of classical interpolation polynomials, Continuity conditions, Iso-parametric elements, Numerical integration in one, two and three-dimensions.

Module-IV

SOLID AND STRUCTURAL MECHANICS

Introduction, Basic equations of solid mechanics, Static analysis-Formulation of equilibrium equations, analysis of trusses and frames, analysis of plates, analysis of three-dimensional problems, analysis of solids of revolution, Dynamic analysis-Dynamic equations of motion, consistent and lumped mass matrices, consistent mass matrices in global coordinate system, Dynamic response calculation using FEM

Module-V

APPLICATIONS AND GENERALISATON OF THE FINITE ELEMENT METHOD

Energy balance and rate equations of heat transfer, Governing differential equation for the heat conduction in three-dimensional bodies, Derivation of finite element equations for one-dimensional, two-dimensional, unsteady state and radiation heat transfer problems and their solutions, Solution of Helmholtz equation and Reynolds equation, Least squares finite element approach.

RECOMMENDED BOOKS :

1. The Finite Element Method in Engineering – S.S. Rao, Pub.- Pergamon Press.
2. Numerical Methods in Finite Element Analysis—Klaus-Jurgen Bathe and Edwar L. Wilson, Pub.-PHI.
3. The Finite Element Method – O.C. Zienkiewicz – McGraw-Hill
4. The Finite Element Methods for Engineers – K.H. Huebner – Wiley, New York

Course Outcomes:

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

CO1	understand Basic concept of FEM
CO2	Understand Formulation of element
CO3	Understand high-- order and iso-parametric element formulations
CO4	Understand solid and structural mechanics
CO5	Understand Energy balance and rate equations of heat transfer

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.Tech. Industrial &Production Engineering (VIII-Semester) AICTE

Credits: 4	**IP804A**	**Management information system**	**L: 3, T:0,P:0**

Course objectives

1. To enable graduate to concept of concep ttalize and manage the specification design and implementation of MIS system'
2. To provide the knowledge of various types of system'.
3. To aware the students about the various information system solution likeERP,CRM, SCM & BPR.

Module-I

Management Information System (MIS): Concept of MIS, Definition, role of Management Information System , Objectives and benefits, MIS as strategic tool, obstacles and challenges for MIS, functional and cross functional systems, hierarchical view of CBIS, structured and unstructured decision, Decision process and MIS, information system components and activities, Value chain and MIS support. Database and data structures.

Module-II

System Engineering : System concepts, System control , Types of System, handling System, complexity system, efficiency and effectiveness, classes of system ,data processing system, business function processing system transaction processing system, Integrated information processing system, application processing system ,system analysis, need for system analysis, procedure for analyzing the existing system, work system model and comparison with input-process-output model, five views of work system, knowledge based systems.

Module-III

Information and e business technology : Information concepts, classification of information method of data and information collection ,Value of information, information storage and retrieval system ,general model of a human as an information processor, MIS and the Information and knowledge, introduction to e business, models of e business ,MIS in web environment, MIS and e business, Information technology and computer NW support to MIS

Module-IV

Planning and control Concepts: concept of corporate planning, dimensions of planning, Essentiality of strategic planning, Development of business strategic, types of strategies, tools of planning,MIS strategic business planning ,(SDLC) system development life cycle ,system investigation, analysis of needs, design and implementation phases, Control and Maintenance of Information Systems.

Module-V

Enterprise management System: EMS system concept, Enterprise resource planning(ERP)system ERP models and modules ,benefits of ERP,ERP product Evolution, ERP implementation(ERP) from MRP, information management in SCM, Customer relationship management (CRM),Integrated data model in ER. Business Process Re-Engineering (BPR), significance and functions,.

References

1. Davis and Olson, Management Information Systems, TMH
2. James O' Brian, Management Information Systems, TMH
3. Oz, Management Information Systems, Cengage
4. Alter Stevenson, Information Systems: Foundation of E-Business; (Prentice-Hall,USA)
5. Jayaraman, Business Process Re-Engineering, TMH.
6. Garg. V.K.; ERP, PHI
7. Kelkar SA; Management Information Systems A Concise Study; PHI Learning.

8. Radhakrishnan R and Balasuramanian S; Business Process Reengineering; PHI Learning.
9. Alex Leon ; ERP, TMH
10. Jawadekar WS; MIS- text and cases; TMH

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

CO1	understand the uses of MIS in organization and constituent of MIS'
CO2	Understand functional MIS and clarification of MIS'
CO3	Learn the function and issue of each stage of system development
CO4	Understand about emerging MIS technologies like ERP' CRM' SCM 'and treads in enterPrise application
CO5	Understand planning and control concept

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

IP804B -WORK DESIGN AND ERGONOMICS

Module-I
Introduction to work study - Productivity – scope of motion and time study - Work methods design.

Module-II
Motion study-process analysis – process chart – flow diagram – assembly process chart – man and machine chart – two handed process chart - Micro motion and memo motion study. Work measurement and its methods.

Module-III
Work sampling – Determining time standards from standard data and formulas – Predetermined motion time standards – work factor system – methods time measurement, Analytical Estimation.

Module-IV
Measuring work by physiological methods – heart rate measurement – measuring oxygen consumption– establishing time standards by physiology methods.

Module-V
Motion economy- Ergonomics practices – human body measurement – layout of equipment – seat design - design of controls and compatibility – environmental control – vision and design of displays. Design of work space, chair table.

RECOMMENDED BOOKS :

1. Barnes, Raeph.m., "Motion and Time Study – Design and Measurement of Work ", John Wiley & sons, New York, 1990.
2. Mc.Cormick, E.J., "Human Factors in Engineering and Design", Mc.Graw Hill.
3. ILO, "Introduction to Work study ", Geneva, 1974.

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

CO1	understand Work methods design.
CO2	Understand Motion study-process analysis
CO3	Understand work sampling
CO4	Measure work by physiological methods
CO5	Understand Motion economy

IP804C Concurrent Product Design

Module-I
Introduction: Types of design, importance of design, design considerations, product life cycle, technology life cycle, benchmarking and mass customization. Concurrent design team its elements.

Module-II
Product Design Process: Steps in design, Functional requirement analysis, Axiomatic design, Product design specifications, concurrent design model.

Module-III
Material And Manufacturing Process Selection In Design: Factors influencing material and process selection, approaches, tools and software used in selection. Design For 'X': An introduction: Design for manufacturing, assembly and dissemble, an overview of DF'X'. Deign for maintainability and serviceability, design for environment, design for aesthetic, design for packaging, design for handling, design for safety, etc.

Module-IV
Design Cost Estimation: Need, cost indexes, categories; cost-capacity factors; design to cost and life cycle costing.

Module-V
Product Development Approaches: Concurrent engineering, partnership with supplier, collaborative and Internet based design, Design Project Management: PDM tools.

Reference Books

1. Dieter George E., Engineering Design, McGraw Hill Publication, 2000.
2. Ulrich Karl T and Eppinger Steven D., Product design and development, McGraw Hill Publication, 1995.
3. Chitale A.K. and Gupta R.C. Product Design and Manufacture, Prentice-Hall of India, New Delhi
4. Bralla, James G., Handbook of Product Design for Manufacturing, McGraw Hill Publication

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

CO1	understand , product life cycle,
CO2	Understand Product Design Process
CO3	Understand Material And Manufacturing Process Selection In Design
CO4	Understand Design Cost Estimation
CO5	Understand Product Development Approaches

COMPUTER INTEGRATED MANUFACTURING LAB
(IP801)

Laboratory Assignments:

1. To prepare planning sheet using CAPP from conventional process planning sheet.
2. To study and prepare sheet of G codes for various controllers.
3. To study and prepare sheet of M codes for various controllers.
4. To prepare part programs in APT for various machining operations.

   To prepare cellular layout from the existing conventional layout,(Industry supported case study).

COMPUTER AIDED DESIGN LAB
(IP802)

List of Experiment (Pl. Expand it):

1. Preparation of 2-D drawings using various 2-D commands.

2. Preparation of 3-D drawings for machine components.

3. 3-D modeling - solid, surface, wireframe using standard CAD packages - Assembly of standard parts created using 3-D model.

4. Parametric modeling, creating standard machine parts, connecting rod, flange coupling, bearings Analysis of simple machine parts by meshing into finite element

MANAGEMENT INFORMATION SYSTEM LAB
(IP804)

List of Experiment (Pl. Expand it):

1. To prepare a report of survey/Study conducted in the industry/office where M.I.S. is implemented.

2. To prepare a report for implementing M.I.S. in the system (Industry/office) where M.I.S. is not Existing, stating clearly Advantages, that will be achieved by the organization by implementing M.I.S.

PROJECT-II
(IP805)

Objectives of the course Minor/Major Project are:

1. To provide students with a comprehensive experience for applying the knowledge gained so far by studying various courses.
2. To develop an inquiring aptitude and build confidence among students by working on solutions of small industrial problems.
3. To give students an opportunity to do some thing creative and to assimilate real life work situation in institution.
4. To adapt students for latest development and to handle independently new situations.
5. To develop good expressions power and presentation abilities in students.

The focus of the Major Project is on preparing a working system or some design or understanding of a complex system using system analysis tools and submit it the same in the form of a write up i.e. detail project report. The student should select some real life problems for their project and maintain proper documentation of different stages of project such as need analysis market analysis, concept evaluation, requirement specification, objectives, work plan, analysis, design, implementation and test plan. Each student is required to prepare a project report and present the same at the final examination with a demonstration of the working system (if any)

Working schedule The faculty and student should work according to following schedule:

Each student undertakes substantial and individual project in an approved area of the subject and supervised by a member of staff.The student must submit outline and action plan for the project execution (time schedule) and the same be approved by the concerned faculty.

Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Information Technology)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical			L	T	P	
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work					
1	IT801	PCC	Information and Cyber Security	70	20	10	30	20	150	3	-	2	4
2	IT802	PCC	Data Mining	70	20	10	30	20	150	3	-	2	4
3	IT803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	IT804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	IT805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	IT803A	Network Management
2	IT803B	Netural Language Processing
3	IT803C	Sensor Netwokrs

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	IT804A	Internet of Things
2	IT804B	Image Processing and GIS
3	IT804C	Computer Vision

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit	1 hour Tutorial (T) = 1 credit	2 hour Practical (P) = 1 credit

Jabalpur Engineering College, Jabalpur, M.P.

PROGRAMME: B.Tech. (VIII-Semester) AICTE

Information Technology

(w.e.f. July 2017-18 batch)

Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work					
IT801	Information and Cyber Security	70	20	10	30	20	150	3	-	2	4

COURSE CONTENTS

Module I: Basic of Cryptography, secret key cryptography, Types of attack, Substitution ciphers, Transposition ciphers, block ciphers and steam ciphers, Confusion and Diffusion, Data encryption standard, round function, modes of operation, cryptanalysis, brute force attack, Security Goals (Confidentiality, Integrity, Availability).

Module II: Public key Cryptography, Modulo arithmetic, Greatest common divisor, Euclidean algorithm, RSA algorithm, hash function, attack on collision resistance, Diffie hellman key exchange, Digital signature standard, elliptic curve cryptography.

Module III: Authentication: One way Authentication, password based, certificate based, Mutual Authentication ,shared secret based, Asymmetric based, Authentication and key agreement, centralized Authentication, eavesdropping, Kerberos, IP security overview:- security association & Encapsulating security payload ,tunnel and transfer modes, internet key exchange protocol, Secure Socket Layer(SSL), Transport Layer Security (TLS).

Module IV: Software vulnerabilities: Phishing Attacks, buffer overflow vulnerability, Format String attack, Cross Site Scripting, SQL injection Attacks, Email security:- Security services of E-mail ,Establishing keys, Privacy ,Authentication of the source, Message integrity ,Non-Repudiation, Viruses, Worms, Malware.

Module V: Web Issue: Introduction, Uniform Resource Locator/uniform resource identify, HTTP, Cookies, Web security problem, Penetration Testing, Firewalls:- functionality, Polices and Access Control, Packet filters, Application level gateway, Encrypted tunnel, Security architecture, Introduction to intrusion detection system.

References:-

- Bernard Menezes, " Network Security and Cryptography", CENGAGE Learning.
- Charlie Kaufman, " Network Security", PHI.
- Forouzan, "Cryptography & Network Security",
- TMH Randy Weaver, " Network Infrastructure Security", Cengage Learning.
- Atual Kahate, " Cryptography and Network Security", TMH.
- William Stalling, " Cryptography and Network security", Pearson.

Course Outcomes:

CO1: To give overview of cryptography and DES.

CO2: To understand various cryptography algorithms.

CO3: To familiarize with the different authentication techniques.

CO4: To introduce various software vulnerabilities.

COs/POs	1	2	3	4	5	6
1	*					*
2	*	*				
3	*		*			
4	*			*		

Jabalpur Engineering College, Jabalpur, M.P.

PROGRAMME: B.Tech. (VIII-Semester) AICTE

Information Technology

(w.e.f. July 2017-18 batch)

Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT802	Data Mining	70	20	10	30	20	150	3	-	2	4

COURSE CONTENTS

Module I- DATA WAREHOUSING:

Data warehousing Components –Building a Data warehouse –- Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata.

Module II-BUSINESS ANALYSIS:

Reporting and Query tools and Applications – Tool Categories – The Need for Applications – Cognos Impromptu – Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multirelational OLAP – Categories of Tools – OLAP Tools and the Internet.

Module III -DATA MINING:

Introduction – Data – Types of Data – Data Mining Functionalities – Interestingness of Patterns – Classification of Data Mining Systems – Data Mining Task Primitives – Integration of a Data Mining System with a Data Warehouse – Issues –Data Preprocessing.

Module IV -ASSOCIATION RULE MINING AND CLASSIFICATION:

Mining Frequent Patterns, Associations and Correlations – Mining Methods – Mining Various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining – Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Backpropagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods - Prediction

Module V -CLUSTERING AND APPLICATIONS AND TRENDS IN DATA MINING:

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods – Kmeans – Partitioning Methods – Hierarchical Methods - Density-Based Methods –Grid Based Methods –

Model-Based Clustering Methods – Clustering High Dimensional Data - Constraint – Based Cluster Analysis – Outlier Analysis – Data Mining Applications.

TEXT BOOKS:

1. Alex Berson and Stephen J. Smith, " Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
2. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Second Edition, Elsevier, 2007.

REFERENCES:

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, " Introduction To Data Mining", Person Education, 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, " Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
4. Daniel T.Larose, "Data Mining Methods and Models", Wile-Interscience, 2006.

Course Outcomes:

CO1: To introduce with data warehousing components.

CO2: To familiarize with data mining and integration with a data warehousing.

CO3: To understand association rules and its classifications.

CO4: To introduce various software vulnerabilities.

COs/POs	1	2	3	4	5	6
1	*					
2	*					
3	*	*		*		
4	*		*	*		

Jabalpur Engineering College, Jabalpur, M.P.

PROGRAMME: B.Tech. (VIII-Semester) AICTE

Information Technology

(w.e.f. July 2017-18 batch)

Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT803A	Network Management	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module I

Protocols and architecture, Protocols, Characteristics, Functions, Need for multiple protocols, Conceptual layers of multiple protocol software, Protocol layering principles, Multiplexing and Demultiplexing.

Module II

Internet Protocol , Virtual network , Internet architecture and philosophy , Purpose of the internet protocol , Internet diagram , Routing in an internet , table driven IP internet , IP routing algorithm , Internet control message protocols (ICMP) , Internet protocol version 6 , Features , Format , Source routing , Options , address space assignment , User data gram protocol , Format of UDP messages , UDP encapsulation and protocol layering.

Module III

Introduction, layering, OSI Layering, TCP/IP Layering, Protocols & Standards, Internet standards, Internet administration, Internet Addresses, Internet protocol: introduction, IP header, IP routing, subnet addressing, subnet mask, special case of IP addresses, Comparative Study of IPV4 & IPV6, port numbers Address Resolution Protocol, ARP packet format, Proxy ARP, ARP command, ARP Example, Reverse Address Resolution Protocol (RARP): Introduction, RARP Packet format, RARP Examples, RARP server design

Module IV

Delivery and Routing of IP Packets, Routing Methods, Static versus Dynamic Routing, Routing table and Routing Module, Classless Addressing: CIDR. Internet Protocol (IP), Datagram, Fragmentation, Options, IP Package. Interior and Exterior Routing, Routing information protocol (RIP), Open shortest path first protocol (OSPF), BGP, GGP. Private Networks. Virtual Private Network (VPN), Network Address Translation (NAT).

Module V

Configuration management, Configuration management functions, Inventory managements, Network topology services, Order processing and provisioning, Charge management directory services.

Fault management, Processes and procedure, Fault management functions, Performance management, Security management, accuracy management, Network capacity planning.

Course Outcomes:

CO1: To discuss protocol layering principle and various standard architectures.

CO2: To understand TCP/IP supportive various protocols.

CO3: To compare various routing methods.

CO4: To give overview of configuration management, performance management, accuracy and security management.

COs/POs	1	2	3	4	5	6
1	*					
2	*	*				
3			*			
4				*		

Jabalpur Engineering College, Jabalpur, M.P.

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Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT803B	Natural Language Processing	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module I : Introduction; Origins and challenges of NLP - Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata - English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

Module II : Word Level Analysis : Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff - Word Classes. Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging - Midden Markov and Maximum Entropy models,

Module III : Syntactic Analysis: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar - Dependency Grammar - Syntactic Parsing, Ambiguity, .Dynamic Programming parsing - Shallow parsing - Probabilistic CFG, Probabilistic CYK, Probabilistic LexicaJired CFGs - Feature structures, Unification of feature structures.

Module IV: Semantics and Pragmatics .'Requirements for representation, First-Order Logic, Description Logics - Syntax-Driven Semantic analysis, Semantic attachments - Word Senses, Relations between Senses, Thematic Roles, selectional restrictions.- Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods - Word Similarity using Thesaurus and Distributional methods.

Module V: Application of NLP: intelligent work processors: Machine translation, user interfaces. Man-Machine interfaces, natural language querying, tutoring and authoring systems, speech recognition, commercial use of NLP.

Text Books:

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: A Introduction to Natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2014.
2. Steven Bird, Ewan Klein and Edward Loper, —Natural Language Processing with Python, First Edition, OReiliy Media, 2009.

Reference Books:

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlamie Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Java, OReiliy Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary. —Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Course Outcomes:

CO1: To familiarize with Origins and challenges of NLP, English Morphology and Edit Distance.

CO2: To understand Word Level Analysis Markov models and Part-of-Speech Tagging.

CO3: To understand Context-Free Grammars Syntactic Parsing and CFG.

CO4: To get exposure to Semantics and Pragmatics inNLP.

CO5: To understand application of NLP like intelligent work processors: Machine translation.

CO/PO	1	2	3	4	5	6
1	*					
2		*				
3		*	*			
4				*		*
5					*	*

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Information Technology

(w.e.f. July 2017-18 batch)

Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT803C	Sensor Network	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module I

Basics of Wireless Sensors and Applications, The Mica Mote, Sensing and Communication Range, Design Issues, Energy consumption, Clustering of Sensors, Applications

Module II

Data Retrieval in Sensor Networks, Classification of WSNs, MAC Layer, Routing Layer, High-Level Application Layer Support, Adapting to the Inherent Dynamic Nature of WSNs.

Module III

Sensor Network Platforms and Tools, Sensor Network Hardware, Sensor Network Programming Challenges, Node-Level Software Platforms.

Module IV

Operating System: TinyOS, Imperative Language: nesC, Dataflow Style Language: TinyGALS, Node-Level Simulators, ns-2 and its Sensor Network Extension, TOSSIM.

Module V

Sensor Network Databases : Challenges ,Query Interfaces, High level Database Organization,In-Network Aggregation, Data-centric Storage, Temporal Data.

TEXT BOOKS:

1. Wireless Sensor Networks: An Information Processing Approach, Feng Zhao, Leonidas Guibas, Elsevier Science Imprint, Morgan Kauffman Publishers, 2005, rp2009.

REFERENCES:

1. Adhoc Wireless Networks: Architectures and Protocols, C.Siva Ram Murthy, B.S.Murthy, Pearson Education, 2004
2. Wireless Sensor Networks: Principles and Practice, Fei Hu, Xiaojun Cao, An Auerbach Book, CRC Press, Taylor & Francis Group, 2010
3. Wireless Ad hoc Mobile Wireless Networks: Principles, Protocols and Applications, Subir Kumar Sarkar et al., Auerbach Publications, Taylor & Francis Group, 2008.
4. Wireless Sensor Networks: Signal Processing and Communications Perspectives, Ananthram Swami et al., Wiley India, 2007, rp2009.

Course Outcomes:

CO1: To familiarize with Basics of Wireless Sensors, clustering and Applications.

CO2: To understand Data Retrieval in Sensor Networks and classification.

CO3: To Sensor Network Platforms and Tools .

CO4: To get exposure to query Operating systems and Dataflow Style Language.

CO5: To understand Sensor Network Databases.

CO/PO	1	2	3	4	5	6
1	*					
2		*				
3		*	*			
4				*		*
5					*	*

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Information Technology

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Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT804A	Internet of Things	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module I:

Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Application of IOT.

Module II:

Machine-to-machine (M2M), SDN (software defined networking) and NFV(network function virtualization) for IOT, data storage in IOT, IOT Cloud Based Services.

Module III:

Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IOT, Media Access control.

Module IV:

Sensor Technology , Participatory Sensing, Industrial IOT and Automotive IOT , Actuator, Sensor data Communication Protocols ,Radio Frequency Identification Technology, Wireless Sensor Network Technology.

Module V:

IOT Design methodology: Specification -Requirement, process, model, service, functional & operational view.IOT Privacy and security solutions, Raspberry Pi & arduino devices. IOT Case studies: smart city streetlights control & monitoring.

Reference Book:

1. Rajkamal,"Internet of Things", Tata McGraw Hill publication

2. Vijay Madisetti and Arshdeep Bahga, "Internet of things(A-Hand-on-Approach)" 1st Edition ,Universal Press
3. Hakima Chaouchi "The Internet of Things: Connecting Objects", Wiley publication.
4. Charless Bell "MySQL for the Internet of things", Apress publications.
5. Francis dacosta "Rethinking the Internet of things:A scalable Approach to connecting everything", 1st edition, Apress publications 2013.
6. Donald Norris"The Internet of Things: Do-It-Yourself at Home Projects for Arduino, Raspberry Pi and BeagleBone Black", McGraw Hill publication.

Course Outcomes:

CO1: To familiarize with Internet of things and their applications.

CO2: To understand M2M, SDN and NFV along with cloud based IOT models.

CO3: To understand various design principles like SOAP, REST.

CO4: To get exposure to sensor technology.

CO5: To understand IOT design methodology and IOT case studies.

COs/POs	1	2	3	4	5
1	*				
2		*			
3			*		
4				*	
5					*

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Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assignment	End Sem	Lab Work					
IT804B	Image Processing and GIS	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module -I

Introduction and Fundamentals

Motivation and Perspective, Applications, Components of Image Processing System, Element of Visual Perception, A Simple Image Model, Sampling and Quantization.

Image Enhancement in Spatial Domain

Introduction; Basic Gray Level Functions – Piecewise-Linear Transformation Functions: Contrast Stretching; Histogram Specification; Histogram Equalization; Local Enhancement; Enhancement using Arithmetic/Logic Operations – Image Subtraction, Image Averaging; Basics of Spatial Filtering; Smoothing - Mean filter, Ordered Statistic Filter; Sharpening – The Laplacian.

Module -II

Image Enhancement in Frequency Domain

Fourier Transform and the Frequency Domain, Basis of Filtering in Frequency Domain, Filters – Low-pass, High-pass; Correspondence Between Filtering in Spatial and Frequency Domain; Smoothing Frequency Domain Filters – Gaussian Low-pass Filters; Sharpening Frequency Domain Filters – Gaussian High-pass Filters; Homomorphic Filtering.

Image Restoration

A Model of Restoration Process, Noise Models, Restoration in the presence of Noise only-Spatial Filtering – Mean Filters: Arithmetic Mean filter, Geometric Mean Filter, Order Statistic Filters – Median Filter, Max and Min filters; Periodic Noise Reduction by Frequency Domain Filtering – Bandpass Filters; Minimum Mean-square Error Restoration.

Module --III

Color Image Processing

Color Fundamentals, Color Models, Converting Colors to different models, Color Transformation, Smoothing and Sharpening, Color Segmentation.

Morphological Image Processing

Introduction, Logic Operations involving Binary Images, Dilation and Erosion, Opening and Closing, Morphological Algorithms – Boundary Extraction, Region Filling, Extraction of Connected Components, Convex Hull, Thinning, Thickening

Module --IV

Registration

Introduction, Geometric Transformation – Plane to Plane transformation, Mapping, Stereo Imaging– Algorithms to Establish Correspondence, Algorithms to Recover Depth

Segmentation

Introduction, Region Extraction, Pixel-Based Approach, Multi-level Thresholding, Local Thresholding, Region-based Approach, Edge and Line Detection: Edge Detection, Edge Operators, Pattern Fitting Approach, Edge Linking and Edge Following, Edge Elements Extraction by Thresholding, Edge Detector Performance, Line Detection, Corner Detection.

Module --V

Feature Extraction

Representation, Topological Attributes, Geometric Attributes

Description

Boundary-based Description, Region-based Description, Relationship.

Object Recognition

Deterministic Methods, Clustering, Statistical Classification, Syntactic Recognition, Tree Search, Graph Matching

Books:

1. Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
2. Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: John Wiley and Sons, NY.
3. Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall, Upper Saddle River, NJ.
4.Digital Image Processing by A.K. Jain, 1995,-PHI

Course Outcomes:

CO1: To Introduce fundamentals of IP, applications and components of Image Processing System along with Image Enhancement in Spatial Domain

CO2: Image Enhancement in Frequency Domain and Image Restoration process and models.

CO3: To understand Color Image Processing and Morphological Image Processing

CO4: To get exposure to Geometric Transformation, Segmentation and

CO5: To understand Feature Extraction and Description, Object Recognition.

CO/PO	1	2	3	4	5	6
1	*					
2		*				
3		*	*			
4				*		*
5					*	*

Jabalpur Engineering College, Jabalpur, M.P.

PROGRAMME: B.Tech. (VIII-Semester) AICTE

Information Technology

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Subject Code	Subject Title	Maximum Marks allotted						Hours/week			Total Credits
		Theory			Practical		Total Marks	L	T	P	
		End Sem	Mid Sem MST	Quiz Assign ment	End Sem	Lab Work					
IT804C	Computer Vision	70	20	10	-	-	100	3	-	-	3

COURSE CONTENTS

Module I : Introduction to Computer vision Human Vision : linage Formation and understanding, pixel- and color transform, classical filtering operations, histogram operations, thresholding techniques, edge detection, techniques, corner and interest point, Introduction to computer vision.

Module II: Feature Detection *and* Matching: Introduction to Feature Representation, colorhistogram analysis, colormoments, texture analysis, Harris detector, Feature descriptors, SIFT, image Matching, Feature distance, euclidean distance feature and dimensionality reduction, principal component analysis.

Module III Shape and Region Analysis: Binary shape analysis, connectedness, object labeling and counting, size filtering, skeletons and thinning, deforrnabte shape analysis, boundary tracking procedures, shape models and shape recognition, boundary length measures, boundary descriptors, chain codes, Fourier descriptors, region descriptors.

Module IV: Image Retrieval: Introduction to Classification and learning techniques, k nearest neighbour, support vector machines, use in Image Retrieval for applications. Accuracy Measurements (Precision, Recall, Sensitivity and Specificity) and Cross Validation Models. Introduction to 3D Vision and Motion.

Module V : Application and Research in Computer Vision: Object Detection, Photo album, Face detection, Face recognition, Eigen faces, Active appearance and 3D shape models of faces Application: Surveillance, foreground-background separation, particle filters, combining views from multiple cameras, human gait, analysis Application : In-vehicle vision system: locating road way road marking – identifying road signs - locating pedestrians.

Lab Work

Students will be given a few computer vision problems. They need to solve the given problems by applying the appropriate techniques studied in this subject.

Text Books:

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012,
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 201

Reference Books:

1. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
2. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012.
3. D. L. Baggio et al "Mastering OpenCV with Practical Computer Vision Projects", Packt Publishing, 2012.
4. Jan Erik Solem, "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media, 2012.

Course Outcomes:

CO1: To introduce Computer vision similarity with Human Vision.

CO2: To understand Feature Detection *and* Matching.

CO3: To understand Shape and Region Analysis.

CO4: To get exposure to Image Retrieval.

CO5: To understand application and Research in Computer Vision.

CO/PO	1	2	3	4	5	6
1	*					
2		*				
3		*	*			
4				*		*
5					*	*

Jabalpur Engineering College, Jabalpur

(Declared Autonomous by MP Govt., Affiliated to RGPV, Bhopal)

(AICTE Model Curriculum Based Scheme)

Bachelor of Technology (B.Tech.) VIII Semester (Mechanical Engg.)

w.e.f. July 2017-18 batch

S.No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours Per Week			Total Credits
				Theory			Practical						
				End. Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem.	Lab Work		L	T	P	
1	ME801	PCC	Advance Machine Design	70	20	10	30	20	150	3	-	2	4
2	ME802	PCC	Automobile Engineering	70	20	10	30	20	150	3	-	2	4
3	ME803	PEC	Professinal Elective Course-III	70	20	10	-	-	100	3	-	-	3
4	ME804	OEC	Open Elective Course-IV	70	20	10	-	-	100	3	-	-	3
5	ME805	PI	Project-II (Testing & Implementation)	-	-	-	150	100	250	-	-	12	6
			Total	**280**	**80**	**40**	**210**	**140**	**750**	**12**	**-**	**16**	**20**
NSS/NCC/Swachhata Abhiyan/Rural Outreach				Qualifier									

Note: Departmental BOS will decide list of four elective subjects for each PEC (Program Elective Course) / OEC (Open Elective Course).

Professional Elective Course-III		
S.No	**Subject Code**	**Subject Name**
1	ME803A	CAD/CAM/CIM
2	ME803B	Tribology
3	ME803C	Advance Machining Processes

Open Elective Course-IV		
S.No.	**Subject Code**	**Subject Name**
1	ME804A	Energy Conservation & Audit
2	ME804B	Data Analysis
3	ME804C	Management Information System

PEC: Professional Elective (Branch Specific), OEC: Open Elective Course (Interdisciplinary), PCC: Professional Core Course, DLC/PI: Digital Learning

1 hour lecture (L) = 1 credit | 1 hour Tutorial (T) = 1 credit | 2 hour Practical (P) = 1 credit

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME801	Advance Machine Design	L: 3, T: 0, P: 2

Course Objective

- Understand the design concepts of belt, rope and chain drives.
- Able to design different types of gears.
- Able to design I.C. Engine components, different types of couplings and power screw.

Course Contents:

Module-I: Design of Belt, Rope and Chain Drives: Methods of power transmission, designof flat belt drive and V-belt drive; Design of chain drives, roller chain and its selection;Design of rope drives.

Module-II: Spur and Helical Gears: Force analysis of gear tooth, AGMA Bending stress equation and AGMA Contact stress equation, modes of failure, beam strength, Lewisequation, form factor, formative gear and virtual number of teeth; Gear materials; Surface strength and wear of teeth; strength against wear; Design of straight tooth spur gear and Helical Gears.

Module-III: Bevel Gears: Application of bevel gear, formative gear and virtual number of teeth; Force analysis; Lewisequation for bevel gears; Strength against wear; Design of bevel gear.

Module-IV: Design of I.C. Engine Components: General design considerations in I C engines; design ofcylinder; design of piston and piston-rings; design of connecting rod; design of crankshaft.

Module-V: Design of Miscellaneous Components: Design of Flanged coupling; Rigid coupling and Flexible coupling, Design of Pressure vessels subjected to internal pressure, Design of power screw.

References:

1. Shigley J.E.; Machine Design; TMH
2. BhandariVB; Design of Machine Elments; TMH
3. Sharma CS and Purohit K; Design of Machine Elements; PHI Learning.
4. Hall and Somani; Machine Design; Schaum Series; TMH
5. Wentzell TH; Machine Design; Cegage Learning
6. Sharma & Agrawal; Machine Design; Katson
7. Kulkarni SG; Machine Design; TMH
8. Abdul Mubeen; Machine Design; Khanna Publishers
9. Juvinall RC, Marshek KM; Fundamentals of Machine Component Design; Wiley
10. Norton R; Design Of Machinery; TMH
11. P.C.Gope- Machine Design

Note: PSG Design data book and/ or Mahadevan and Reddy's Mechanical design data book are to be provided/ permitted in exam hall (duly verified by authority)

Course Outcomes:

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

CO1	Analyze belt, rope and chain drives.
CO2	Select different types oftransmission elements.
CO3	Examine I.C.Engine Components (cylinder,piston, piston-rings, connecting rod and crankshaft.)

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	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	-
CO3	1	2	3	3	1	-	-	-	-	-	-	-

List of Experiments:

1. Design of belt, chain and rope drive.
2. Design of spur and helical gear.
3. Design of bevel gears.
4. Design of I.C. engine components.
5. Design of miscellaneous components.

Course Outcome:

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

CO1	Design the various different machine components.
CO2	Select the various machine components for desired output.

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	2	2	-	-	-	-	-	-	-	-	-
CO2	1	2	1	1	-	-	-	-	-	-	-	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 4	ME802	AUTOMOBILE ENGINEERING	L: 3, T: 0, P: 2

COURSE OBJECTIVE:

The students will be made to learn.

- The anatomy of the automobile in general.
- The location and importance of each part of automobile.
- The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels, suspension, frame, springs and other connections.
- The effect of automobile emissions on environment and how to control pollution.

Course Contents:

Module-I: Chassis & Body Engineering: Types, Technical details of commercial vehicles, types of chassis, layout, types of frames, testing of frames for bending & torsion on unutilized body frame, vehicle body and their construction, driver's visibility and methods for improvement, safety aspects of vehicles, vehicle aerodynamics, optimization of body shape, driver's cab design, body materials, location of engine, front wheel and rear wheel drive, four wheel drive.

Module-II: Steering System: front axle beam, stub axle, front wheel assembly, Wheel Alignment, principles of types of wheel alignment, front wheel geometry viz. camber, Kingpin inclination, castor, toe-in and toe-out, condition for true rolling motion, centre point steering, directional stability of vehicles, steering gear, power steering, slip angle, cornering power, over steer & under steer, gyroscopic effect on steering gears.

Module-III: Transmission System: Function and types of clutches, single plate, multi-plate clutch, roller &spring clutch, clutch lining and bonding, double declutching, types of gear boxes, synchronizer, gear materials, determination of gear ratio for vehicles, gear box performance at different vehicle speed, automatic transmission, torque converters, fluid coupling, principle of hydrostatic drive, propeller shaft, constant velocity universal joints, differential gear box, rear axle construction, Introduction to Electric and Hybrid Power train.

Module-IV: Suspension system : Basic suspension movements, Dependent and Independent Suspension, Independent front & rear suspension, shock absorber, type of springs: leaf spring, coil spring, air spring, torsion bar, location of shackles, power calculations, resistance to vehicle motion during acceleration and breaking, power & torque curve, torque & mechanical efficiency at different vehicle speeds, weight transfer, braking systems, disc theory, mechanical, hydraulic & pneumatic power brake systems, performance, self-energization, air-bleeding of hydraulic brakes, types of wheels and tyres, tyre specifications, construction and material properties of tyres& tubes.

Module-V: Electrical and Control Systems: Storage battery, construction and operation of lead acid battery, testing of battery, principle of operation of starting mechanism, different drive systems, starter relay switch, regulator electric fuel gauge, fuel pump, horn, wiper, lighting system, head light dazzling, signaling devices, battery operated vehicles, choppers, importance of maintenance, scheduled and unscheduled maintenance, wheel alignment, trouble Shooting probable causes & remedies of various systems, microprocessor based control system for automobile, intelligent automobile control systems. Emission standards and pollution control: Indian standards for automotive vehicles-Bharat I, II, III, IV, Euro I to Euro VI norms, fuel quality standards, environmental management systems for automotive vehicles, catalytic converters, fuel additives, and modern trends in automotive engine efficiency and emission control.

References:

1. Crouse, Automotive Mechanics TMH.
2. Srinivasan S; Automotive engines; TMH
3. Gupta HN; Internal Combustion Engines; PHI;
4. Joseph Heitner, Automotive Mechanics, Principles and Practices, CBS Pub.
5. Kripal Singh, Automotive Engineering Khanna Pub.
6. Newton &Steeds, Automotive Engineering
7. Emission standards from BIS and Euro –I to Euro-VI

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

CO1	Enlist the major parts of an automobile
CO2	Analyze the steering, transmission, suspension, electrical and control systems of an automobile.
CO3	Explain the environmental implications of automobile emissions.

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	2	1	-	-	-	-	-	-	-	-	-
CO3	2	-	1	-	-	-	1	-	-	-	-	-

List of Experiments:

1. Study of frame and chassis.
2. Study of clutches – single plate, multi plate and centrifugal
3. Study of gear boxes – sliding mesh, constant mesh, synchro-mesh.
4. Study of differential, universal joints, axles and slip joints.
5. Study of brakes – mechanical, hydraulic, air brake and disc brake.
6. Study of steering system used with rigid axle suspension and independent suspension system, powersteering
7. Study of rigid axle suspension system.
8. Study of independent suspension system.
9. Study of battery, starting and generating system and battery charging system.

Course Outcomes: At the complition of the course student will be able to:

1. Differentiate between different part of an automobile.
2. Investigate the different parts of the automobile.

Mapping of Course Outcomes with Program Educational Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1					2	1	1		2		
CO2					1	1	1		2		

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester)AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803A CAD /CAM/ CIM L: 3, T: 0, P: 0

Course Objective

- Understand the concepts of product design in CIM environment.
- Able to Create mathematical models to characterize curves and surfaces.
- Understand the Concepts ofNumeric control and part programming.
- Able to show the elements of an automated manufacturing environment.

Course Contents:

Module-I : Introduction: Information requirements of mfg. organizations; business forecasting and aggregate production plan; MPS, MRP and shop floor/ Production Activity Control (PAC); Mfg. as a system, productivity and wealth creation; production processes on volume-variety axes; importance of batch and job shop production; CIM definition and CIM wheel, evolution and benefits; CIM as a subset of Product Life Cycle (PLC) mgt; design for mfg. (DFM) and concurrent engg; product design in conventional and CIM environment; terms like CAD, CAE, CAM, CAP, CAPP, CATD and CAQ.

Module-II: Graphics and standards: Raster scan, coordinate systems for model (M/ WCS) user and display; database for graphic modelling; PDM, PIM, EDM; define EDM, features of EDM; basic transformations of geometry- translation, scaling, rotation and mirror; introduction to modelling software; need for CAD data standardization; developments in drawing data exchange formats; GKS, PHIGS,
CORE, IGES, DXF, STEP, DMIS AND VDI; ISO standard for exchange of Product Model data-STEP and major area application protocols.

Module-III: Geometric Modelling: Its use in analysis and mfg.; 2D and 3D line, surface and volume models; linear extrusion and rotational sweep; Constructive Solid Geometry (CSG); basics of boundary presentation- spline, Bezier, b-spline, and NURBS; sculpture surfaces, classification, basics of coons,
Bezier, b-spline and ruled surfaces; tweaking, constraint based parametric modelling; wire-frame Modelling, definition of point, line and circle; polynomial curve fitting; introduction to rapid prototyping.

Module-IV: Numeric control and part programming: Principles of NC machines, CNC, DNC; NC modes of point to point, -line and 2D, 3D contouring; NC part programming; ISO standard for coding, preparatory functions(G)- motion, dwell, unit, pre-set, cutter compensation, coordinate and plane selection groups; miscellaneous (M) codes; CLDATA and tool path simulation; ISO codes for turning tools and holders; ATC, modular work holding and pallets;

time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC; simple part programming examples.

Module-V: Group Technology: Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling; robots, AGV and their programming; agile mfg; Computer Aided Process Planning (CAPP), variant/ retrieval and generative approach

References:

1. S.KantVajpay; Principles of CIM; PHI
2. Rao PN; CAD/CAM; TMH
3. Groover MP; Automation, Production Systems & CIM; P.H.I.
4. Rao PN, Tiwari NK, Kundra TK; Computer Aided Manufacturing; TMH
5. Alavudeen A, Venkteshwarn N; Computer Integrated Mfg; PHI
6. Radhakrishnan P, Subramanian S and Raju V; CAD/CAM/CIM; New age Pub

Course Outcomes:

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

CO1	Analyze geometric transformations and CAD models.
CO2	Develop and validate CNC programs to manufacture engineering components.
CO3	Illustrate the elements of group technology in an automated manufacturing environment.

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	2	3		1							
CO2	1	2	2		2							
CO3	1	1	2								1	

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803B Tribology L: 3, T: 0, P: 0

Course Objective:

To study the basic principles governing the tribology and apply them to reduce friction and wear in mechanical machines and structures.

Module-I: Introduction, history of tribology, early scientific studies of - friction, wearand lubrication. Tribo-Surface preparations and characteristics. Surface contacts, Hertz contact stresses, residual stress, surface fatigue, creep, stress relaxation, fracture mechanics, elastic, viscoelastic and plastic behavior of materials. Choice of materials.

Module-II: Friction, laws of friction, rolling/sliding friction, theory of adhesion and abrasion, different mechanisms of friction, stick slip characteristics, interface temperature, thermal analysis, Molecular mechanical theory of friction, operating conditions and system parameters, calculations of coefficient of friction, design of friction devices.

Module-III: Wear, different types of wear mechanisms, adhesive, abrasive impact,percussion erosion, fretting wear calculations of wear rate, two body/ three body wear, wear prevention, wear of metal cutting and metal forming tools, wear mapping of materials, cavitation, surface fatigue, corrosion, performance levels classifications and specifications of lubricants

Module-IV: Lubrication, lubricants and additives, composition and properties of lubricants, maintenance of oil and emulsions, industrial hygiene aspects, technical regulations for lubricants. boundary/ mixed and fluid film lubrication, industrial methods of lubrications, SAE,BIS, ASTM, IP, DIN Standards, oil testing's, wear and chemistry of lubricants.

Module-V: Nano tribology, Instrumental tests, Bearings, clutches and brakes, Commonly used bearing materials, and properties of typical bearing materials, slide units, dynamic seals, Automobile applications, machine tools/ press machines applications. Other applications and case studies.

Evaluation:

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

References:

1. Principles and applications of tribology, Bharat Bhushan, John Wiley& sons, ISBN 0471
   594075.
2. Tribology,, - lubrication ,friction and wear, I V Kragelsky and V VAlisin, Mir publication,
   ISBN 1860582885.
3. Applied Tribology,M MKhonsari and E. R. Booser, John Wiley, ISBN 0471283029.

Tutorial topics:

1. Testing equipments of tribology.
2. Various industrial applications of tribology.
3. NEMS and MEMS applications
4. Solid, liquid and mist/ gas lubricants.
5. Surface coatings.
6. Chemical analysis of materials
7. Various simulations
8. AFM/ FFM , SFA, STM, studies.

Course Outcomes:

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

CO1	Infer thebasic principles governing the wear, friction and lubrication..
CO2	Examine the different mechanisms of friction and develop friction devices.
CO3	Illustrate the various modes of lubrication.
CO4	Analyze various mechanical machines and structures against wear and friction.

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	1	1	-	-	-	-	-	-	-	-	-
CO2	1	2	2	1	-	-	-	-	-	-	-	-
CO3	2	-	1	-	-	-	-	-	-	-	-	-
CO4	1	2	2	2	-	-	-	-	-	-	-	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 PEC-IV ME803C Advance Machining Processes L: 3, T: 0, P: 0

Course Objectives:

- Understand the fundamentals and technologies used in different advance machining processes.
- Apply the characteristics and applications of the product obtained using advanced manufacturing processes.
- Compare different advance machining processes.

Course Contents:

Module-I: Mechanical processes: Process selection, mechanics of cutting, metal removal rate, cuttingtool system design, ultrasonic machining, abrasive jet machining, water jet machining, effect of parameters and variables, applications and limitations, recent developments inmechanical processes.

Module-II: Electrochemical and chemical metal removal processes: Electrochemical machining[ECM],elements of ECM, power source and control system, electrolytes, tool work system,chemistry of the process, tool design and metal removal rate, process faults, materialremoval and surface finish, electrochemical grinding, electrochemical deburring,electrochemical honing, chemical machining.

Module-III:Thermal metal removal processes: Electric discharge machining[EDM], spark erosion,mechanism of metal removal, spark erosion generator, electrod feed control, vibratingelectrode system, dielectric fluid, flushing, accuracy, plasma arc machining[PAM], nonthermal generation of plasma, mechanisms and parameters, equipments, electron beammachining[EBM],generation and control of electron beam, theory and process capabilities, neutral particle etching, laser beam machining, hot machining, methods of local heating,toollie and production rate.

Module-IV: Rapid prototyping fabrication methods: Fundamentals, Technologies, Applications, Principlesand working of 3D printing, subtractive v/s additive manufacturing process, VAT photopolymerization, material and binder jetting, continuous liquid inter phase production, directmetal laser sintering.

Module-v: Technologies of micro fabrication: Types of micro system devices, Industrial applications,micro fabrication processes, LIGA process .Technologies of nano fabrication, importance of size, scanning probe microscope, carbon Buckyballs and nano tubes, nano fabricationprocesses.

Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing, Wiley India, ISBN 9788126523016
2. Pandey P.C, Shan H.S., Modern Machining Processes, Tata McGraw Hill,ISBN 0070965188
3. Lal G.K,Gupta V, Reddy N.V., Narosa Publishing House,ISBN 8173197091
4. CMTI Handbook

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

CO1	Explain the fundamentals and technologies used in different advance machining processes.
CO2	Predict the characteristics and applicationsof the product obtained using advanced manufacturing processes.
CO3	Compare different advance machining processes.

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	-	-	-	-	-	-	-	-	2
CO2	2	-	2	1	3	-	-	-	-	-	-	1
CO3	3	2	-	1	1	-	-	-	-	-	-	1

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3 OEC-IV ME804A Energy Conservation & Audit L: 3, T: 0, P: 0

Course Objective

- Understand the concepts of energy management and conservation.
- Able to conduct energy audit and report.
- Concepts of Energy policy its purpose and formation.
- Able to do Electrical Energy Management in different electrical systems.

Module-I Energy Management: Concept of energy management, energy demand and supply, economic analysis; Duties and responsibilities of energy managers.
Energy Conservation: Basic concept, energy conservation in Household, Transportation, Agricultural, service and Industrial sectors, Lighting, HAVC.

Module-II Energy Audit: Definition, need and types of energy audit; Energy management (Audit) approach: Understanding energy cost, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirement; Fuel & energy substitution; Energy audit instruments; Energy conservation Act; Duties and responsibilities of energy manager and auditors.

Module-III Material Energy Balance: Facility as an energy system; Method for preparing process flow; material and energy balance diagrams.
Energy Action Planning: Key elements, force field analysis; Energy policy purpose, perspective, content, formulation, rectification

Module-IV Monitoring and Targeting: Definition monitoring & targeting; Data and information analysis.
Electrical Energy Management: energy conservation in motors, pumps and fan systems; energy efficient motors.

Module-V Thermal Energy Management: Energy conservation in boilers, steam turbine and industrial heating system; Application of FBC; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pump; Building Energy Management.

References:

1. Murphy &Mckay, Energy Management, BSP Books Pvt. Ltd.
2. Smith CB; Energy Management Principle, Pergamon Press, New York.
3. Rajan GG, Optimising Energy Efficiency in Industry, TMH.
4. Callaghan P O, Energy Management, McGraw-Hill Book Company.
5. Amit Kumar Tyagi, Handbook on Energy Audit and Management, Tata Energy Research Institute.
6. Bureau of Energy Efficiency, Study material for energy Managers and Auditors: Paper I to V.
7. Hamies; Energy Auditing and Conservation: Method, Measurement…, Hemisphere, Washington.
8. Witty, Larry C, Industrial Enegy Management Utilisation, Hemisphere Publishers, Washington

9. Kreith&Goswami, Energy Management and Conservation Handbook, CRC Press.

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

CO1	Understand the concepts of energy conservation, management and energy efficiency.
CO2	Explain energy audit and preparation of report.
CO3	Examine Energy Management in different electrical/thermal systems.
CO4	Built Material and energy balance diagram and its significance.

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

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	1	-	-	-	-	-
CO2	-	2	3	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	1	-	-	-	-	-	2	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-

Jabalpur Engineering College, Jabalpur (M.P)
PROGRAMME: B.Tech. Mechanical Engineering (VIII-Semester) AICTE
w.e.f. July 2017-18 batch

Credits: 3	OEC-IV ME804C	Management Information System	L: 3, T: 0, P: 0

Course Objective

The objective of this course is to introduce the students to the managerial issues relating to information systems, its role in organization, support for decision-making and how information technology can be leveraged to provide business value.

Course Contents

Module-I: Introduction to MIS
The meaning and use MIS, System View of Business, Process of MIS, Development of MIS within the organization, Management Process, Information Needs, System Approach in Planning Organizing and Controlling MIS. The role of internet- Internet and Web.

Module-II: Data and Information
Introduction, data and information- measuring data, information as a resource, information in organizational functions, types of information technology, types of information systems-transaction processing systems-management information systems

Module-III: Competing with IT
Introduction, The competitive environment of business- partnering for mutual benefit-bargaining power of suppliers-bargaining power of buyers and customers-barriers to entry-threat of substitutes-industry regulations, Using IT for competing-competing on low cost-competing on differentiation.

Module-IV: Electronic Commerce
Introduction, E-commerce Technology, doing business over internet- networks-electronic data interchange (EDI)-online payment technology- Mobile commerce- ecommerce-portals- search engines-direct selling- auctions- aggregators, E-business.

Module-V: Decision Support Systems
Introduction, Characteristics and Objectives, Role of Decision Support Systems and its applications, Components of Decision support Systems, Data Subsystem, Model Subsystem, and User-interface, Group decision support systems (GDSS), Expert systems, Executive Information. Systems and its integration with DSS, Decision-making: Concept, Process, Simon's model, Information System support for Decision Making Phases, Decision making under assumed certainty, risk and uncertainty. Analytics and Business Intelligence- BI techniques.

References

1. James, A. O'Brien, *Introduction to Information Systems,* Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2005.
2. Efraim Turban, Jay E. Aronson and Ting-Peng Liang, *Decision Support Systems and Intelligent Systems,* Prentice-Hall of India, New Delhi, 7th Edition, 2004.

3. George M. Marakas, *Decision Support Systems*, Prentice-Hall of India, New Delhi, 2002.
4. Kenneth C. Laudon and Jane P. Laudon, *Management Information Systems*, Prentice-Hall of India, New Delhi, 9th Edition, 2006.

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	Demonstrate working of MIS within the organization.
CO2	Implementation and integration of Data and Information technologies with MIS.
CO3	Analyze and Estimation of improvement in results using MIS and Decision Support Systems.

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						
CO2				1	1	1						
CO3			2		2		2					