

**CHOICE BASED CREDIT SYSTEM
EVALUATION SCHEME
AND
COURSE OF STUDY
IN
B.TECH.
COMPUTER SCIENCE AND ENGINEERING

(VII and VIII SEMESTER)
SCHEME OF EXAMINATION & SYLLABUS**



**FACULTY OF ENGINEERING AND TECHNOLOGY
GURUKULA KANGRI DEEMED TO BE UNIVERSITY,
HARIDWAR**

SEMESTER-VII

DSC/SEC/DSE/ AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXA M ESE		
		L	T	P	CT	TA	Total			
THEORY										
BCE-C711	Compiler Design	3	1	0	20	10	30	70	100	4
BCE-C712	Linux System Administration	3	1	0	20	10	30	70	100	4
BCE-P7XX	Program Elective –III	3	0	0	20	10	30	70	100	3
BCE-O7XX	Open Elective –III	3	0	0	20	10	30	70	100	3
PRACTICAL										
BCE-C762	Linux System Administration Lab	0	0	2	10	5	15	35	50	1
BCE-P770	Minor Project with research paper	0	0	8	20	10	30	70	100	6
TOTAL		12	2	10	110	55	165	385	550	21

Program Elective Subject List - III

BCE-P713	Wireless Networks
BCE-P714	Information and Network Security
BCE-P716	Human Computer Interaction
BCE-P717	Block Chain
BCE-P718	Deep Learning
BCE-P719	Fuzzy logic and Neural Networks
BCE-P720	Real Time Operating System
BET-P721	Internet of Things
BCE-P722	Natural Language Processing

Open Elective –III

BCE-O731	Optimization Techniques in Computing
BCE-O732	Parallel and Distributed System
BCE-O733	Adhoc and Sensor Networks
BET-O734	BioMedical Signal Processing
BCE-O735	Ecommerce
BCE-O736	Human Resource and Organization Behaviour
BCE-O737	Soft Computing
BCE-O738	Storage Management
BCE-O739	Quantum Computing
BCE-O740	Computer Vision
BCE-O741	AI in Healthcare
BCE-O742	Neural Networks and Deep Learning
BCE-O743	Biometric and Fingerprint Recognition

GURUKULA KANGRI VISHWAVIDYALAYA (Deemed to be University), HARIDWAR
Faculty of Engineering & Technology Computer Science & Engineering
B. Tech. Fourth Year
Syllabus in accordance with AICTE Model Curriculum
SEMESTER-VIII

DSC/SEC/DSE/ AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits
					SESSIONAL EVALUATION			EXA M ESE		
		L	T	P	CT	TA	Total			
THEORY										
BCE-O8XX	MOOC- I	3	1	0	20	10	30	70	100	4
BCE-O8XX	MOOC- II	3	1	0	20	10	30	70	100	4
BCE-O8XX	MOOC- III	3	1	0	20	10	30	70	100	4
PRACTICAL										
BCE-P861	Major Project with Research paper	0	0	16	0	100	100	300	400	9
TOTAL		9	3	16	60	130	190	510	700	21

List of MOOC courses shall be decided by the departmental committee in each semester depending upon the list from SWAYAM/NPTEL and other recognized online platforms. Students have to study from Online Platform doubt sessions shall be held by Internal teachers and exams shall be taken by university. If a student wishes he can give exam of Online Platform for certification. SWAYAM courses to run every year from July onwards (Odd Semester) are declared in the month of May and for courses to run every year from January onwards (Even Semester) are declared in the month of December on website <https://swayam.gov.in/>. **As per AICTE norms One MOOC shall be of Disaster Management.**

Course Code: BCE-C711
Course Name: COMPILER DESIGN

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional:30 ESE:70 Credit :4
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Prerequisites:	Theory of Computation.
Objectives:	● To learn the process of translating a modern high-level language to executable code. ● Provide an understanding of the fundamental principles in compiler design. ● To learn about the different parsing techniques. ● To apply the code generation algorithms to get the machine code for the optimized code. ● To represent the target code in any one of the code formats. ● To understand the machine dependent code. ● To draw the flow graph for the intermediate codes. ● To apply the optimization techniques to have a better code for code generation.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction: What is system software. Introduction to system software. Assembler, Loader, Linker, Interpreter, Compiler.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	Compiler Structure: Compiler and translator, various phases of compiler, pass structure of compiler, bootstrapping of compiler. Lexical Analysis: The role of lexical analyzer, a simple approach to the design of lexical analyzer, regular expressions, transition diagram, finite state machines, Implementation of lexical analyzer, lexical analyzer generator : LEX, capabilities of lexical analyzer.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	Basic Parsing Techniques : Top down Parser with backtracking, recursive descent parsers, predicate parsers, bottom-up parsers, Shift-reduce parsing, operator precedence parsers.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Module-4	Intermediate Code Generator: Different intermediate forms - Three address code, Quadruplex and triples, syntax directed translation mechanism and attributed definition. Translation of Declaration, Assignment, Control flow, Boolean expression, Array in arithmetic expression, procedure calls, case statement, postfix translation.	08	PO1/ PO2/ PO3/ PO5	PSO1/ PSO2
Module-5	Code Optimization and Code Generation: Local optimization, loop, peephole optimization, basic blocks and flow graphs DAG, data flow analyzer, machine model, order of evaluation, register allocation of code selection. Error Detection and Recovery: Lexical phases error, syntactic phase errors, semantic errors.	08	PO1/ PO4/ PO5	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand phases of compiler design and lexical analysis • Apply parsing techniques for syntax analysis • Construct intermediate code representations • Apply optimization techniques for code generation • Use compiler generation tools like LEX and YACC
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Alfred V Aho, Jeffrey D. Ullman, Principles of Compiler Design, Narosa.
2.	V. Aho, R. Sethi and J.D. Ullman, Compiler: Principle, Techniques and Tools, AW.
3.	H. C. Holub, Compiler Design in C, Prentice Hill Inc.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓	✓	✓									✓	✓
CO2	✓	✓	✓	✓									✓	✓
CO3	✓	✓	✓					✓	✓				✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓				✓	✓
CO5	✓	✓	✓		✓			✓	✓				✓	✓

Course Code: BCE-C712
Course Name: LINUX SYSTEM ADMINISTRATION

MM: 100 Time: 3 Hr. L T P 3 1 0	Sessional:30 ESE:70 Credit :4
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Prerequisites:	Basic Operating System knowledge.
Objectives:	To impart knowledge and skills on various practical and theoretical aspects of Linux operating system (OS) basics and Linux OS based server configuration, management and administration.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction: Duties of the Administrator, Administration tools, Overview of permissions. Processes: Process status, Killing processes, process priority. Starting up and Shut down: Peripherals, Kernel loading, Console, The scheduler, init and the inittab file, Run-levels, Run level scripts. Managing User Accounts: Principles, password file, Password security, Shadow file, Groups and the group file, Shells, restricted shells, user management commands, homes and permissions, default files, profiles, locking accounts, setting passwords, Switching user, Switching group, Removing users.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Managing Unix File Systems: Partitions, Swap space, Device files, Raw and Block files, Formatting disks, Making file systems, Superblock, I-nodes, File system checker, Mounting file systems, Logical Volumes, Network File systems, Boot disks Configuring the TCP/IP Networking : Kernel Configuration; Mounting the /proc File system, Installing the Binaries, Setting the Hostname, Assigning IP Addresses, Creating Subnets, Writing hosts and networks Files, Interface Configuration for IP, ifconfig, netstat command, Checking the ARP Tables; Name service and resolver configuration.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	TCP/IP Firewall : Methods of Attack, What Is a Firewall? What Is IP Filtering? Setting Up Linux for Firewalling Testing a Firewall Configuration; A Sample Firewall Configuration: IPAccounting, Configuring the Kernel for IP Accounting, Configuring IP Accounting, Using IPAccounting Results IP Masquerade and Network Address Translation : Side Effects and Fringe Benefits, Configuring the Kernel for IP Masquerade, Configuring IP Masquerade.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	The Network Information System : Getting Acquainted with NIS, NIS Versus NIS+ , The Client Side of NIS, Running an NIS Server, NIS Server Security. Network file system: Preparing NFS, Mounting an NFS Volume, The NFS Daemons, The exports File.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-5	System Backup & Recovery: Log files for system and applications; Backup schedules and methods (manual and automated). Active Directory, LDAP.	08	PO1/ PO2/ PO4/P O5	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand Linux concepts • Perform Linux administration • Configure networking and security • Manage users and file systems • Implement server management
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	L.L. Beck – “System Software “ (3rd Ed.)- Pearson Education
2.	Michel Ticher – “PC System Programming”, Abacus
3.	Kirch – “ Linux network Administrator’s guide (2nd Ed.)” – O’Rielly
4.	E. Nemeth, G. Snyder, S. Seebass, T. R. Hein – “ Unix system administration handbook” – Pearson Education.
5.	Maxwell – “Unix system administration” – TMH
6.	Limoncelli –“The Practice of System & Network Administration”-Pearson 6. Wells, LINUX Installation & Administration, Vikas.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓	✓	✓	✓			✓	✓	✓			✓	✓
CO5	✓	✓	✓		✓			✓	✓	✓			✓	✓

Course Code: BCE-C762
Course Name: LINUX SYSTEM ADMINISTRATION LAB

MM: 50 Time: 2 Hr. L T P 0 0 2	Sessional: 15 ESE: 35 Credit: 01
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Objectives:	The main objectives of the Linux System Administration Lab are: - To provide practical knowledge of installing and configuring operating systems and application software. - To develop skills in user management, security management, and system maintenance in Linux and Windows environments. - To understand startup and shutdown processes along with service management in operating systems. - To introduce students to networking concepts such as IP addressing, subnetting, and firewall configuration. - To familiarize students with Windows Registry and important system services in both Windows and Linux operating systems. - To enhance hands-on experience in troubleshooting and administration of computer systems and networks.
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NOTE:	1. In practical examination the student shall be required to perform one experiment. 2. A teacher shall be assigned 20 students for daily practical work in the laboratory. 3. No batch for practical class shall consist of more than 20 students. 4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students. 5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.
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LIST OF EXPERIMENTS	No. of Hours	POs mapped	PSOs mapped
1. Installation of operating system (Window 7 and LINUX) 2. Installation of office productivity software (MS Office/ Open Office) 3. User Management 4. Security Management 5. Startup & Shutdown scripts 6. Network planning – subnet creation 7. Firewall configuration 8. Basic properties of Windows Registry 9. Study of Important Windows Services 10. Study of Important LINUX Services	03	PO1/ PO2/ PO3/ PO4/ PO5/ PO12	PSO1/ PSO2

Learning Outcomes:	- Understand the installation and configuration process of different operating systems and office productivity software. - Perform user account management, security management, and system administration tasks in Linux and Windows environments. - Configure startup/shutdown scripts, manage important system services, and understand Windows Registry operations. - Design basic network plans, create subnets, and configure firewall settings for secure network communication. - Develop practical skills in handling Linux and Windows administrative tools used in real-world system administration.
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CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√		√								√	√
CO4	√	√		√	√			√	√			√	√	√
CO5	√	√	√	√	√			√	√			√	√	√

Course Code: BCE-P770

Course Name: MINOR PROJECT WITH RESEARCH PAPER

MM: 100 Time: 3 Hr. L T P 0 0 8	Sessional: 30 ESE: 70 Credit: 06
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Objectives:	• Study and identify the problem area by studying and reviewing research papers. • Implement the skills of software engineering and software project management. • Improve upon the communication and presentation skills.
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NOTE:	
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PROJECT DETAILS	No. of Hours	POs mapped	PSOs mapped
Each student shall be assigned a Minor Project by departmental committee. The student shall be required to perform his project work under the supervision of the supervisor(s). There shall be a seminar on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student shall be required to submit his project report in the form of dissertation 15 days before the end of VII semester. The student shall be required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination. ** - Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination. *** - There shall be a seminar on the project work of the student to be evaluated by the departmental committee chaired by H.O.D.	03	PO1/ PO2/ PO3/ PO4/ PO5/ PO9/ PO10/ PO11/ PO12	PSO1/ PSO2

Learning Outcomes:	After successful completion of the course, students will be able to: • Identify real-world problems and apply technical knowledge for team building and project development. • Analyze, design, and develop solutions for practical and industry-oriented problems. • Acquire knowledge of emerging technologies, current research trends, and innovative problem-solving techniques. • Apply software engineering principles and project management practices in project implementation. • Enhance communication, technical writing, presentation, and research documentation skills through seminars, reports, and viva-voce examinations.
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns:Techniques for crafting better presentations (1 ed.), Addison- Wesley, 2012. ISBN 978-0321820808.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√						√	√	√		√	√
CO3	√	√	√	√	√				√	√	√	√	√	√
CO4	√	√		√	√				√	√	√	√	√	√
CO5	√	√	√	√	√				√	√	√	√	√	√

Course Code: BCE-P713

Course Name: WIRELESS NETWORKS

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	Basics of Computer Networks.
Objectives:	The course has following objectives - To study the evolving wireless technologies and standards - To understand the architectures of various access technologies such as 3G, 4G, WiFi etc. - To understand various protocols and services provided by next generation networks.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction: Liberalization of communications Industry, Digitalization of content, changes in spectrum management, cellular reuse, drive towards broadband, IEEE 802.11 networks.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Cellular networks : The GSM circuit switched network, GSM channel structure, Authentication and location updating, physical channels, TMN. GPRS: Introduction to GPRS, contexts, PDP context, Mobility management context, MS-SGSN physical layer, MS-SGSN protocols, GPRS operations.	08	PO1/ PO2	PSO1/ PSO2
Module-3	Circuit voice networks: Introduction to CVN, coverage, capacity, planning for circuit multimedia services Planning for packet multimedia services: Planning approaches, buffer-pipe model, characterization of applications, practical modelling methodologies, multiuser packet transport configurations	08	PO1/ PO2	PSO1/ PSO2
Module-4	Planning and design: RAN, GSM RAN, UMTS RAN, Cellular OFDM RAN, Mesh network.	08	PO1/ PO2/ PO3/PO 4	PSO1/ PSO2
Module-5	Network operation and optimization: Enhanced telecom operations model (eTOM), wireless network life cycle – strategy, infrastructure and product, operations, enterprise management, GSM network performance optimization – principles and key performance indicators, coverage optimization, GPRS RAN optimization, UMTS network performance optimization.	08	PO1/ PO2	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	- Understand wireless communication - Analyze GSM/GPRS architecture
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	• Understand multimedia services • Analyze wireless optimization • Understand emerging technologies
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Deploying Wireless networks, Andy wilton, Tim charity, Cambridge university press
2.	Fundamental of Wireless Networking, Ron Price, TMH
3.	3G Wireless Networks, Clint Smity, TMH
4.	Essentials of UMTS, Christopher Cox, Cambridge University Press

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√					√	√				√	√
CO4	√	√	√	√				√	√			√	√	√
CO5	√	√	√					√	√			√	√	√

Course Code: BCE-P714
Course Name: INFORMATION AND NETWORK SECURITY

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	None.
Objectives:	To study various cryptographic algorithms and network security protocols.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction: Need for security, Introduction to security attacks, services and mechanism, introduction to cryptography, Conventional Encryption: Conventional encryption model, classical encryption techniques- substitution ciphers and transposition ciphers, cryptanalysis, stereography, stream and block ciphers, Intruders, Viruses and related threads.	08	PO1	PSO1/ PSO2
Module-2	Modern Block Ciphers: Block ciphers principals, Shannon's theory of confusion and diffusion, fiestal structure, data encryption standard(DES), strength of DES, cryptanalysis of DES, block cipher modes of operations, triple DES, IDEA encryption and decryption, strength of IDEA, key distribution.	08	PO1/ PO2	PSO1
Module-3	Introduction to graph, ring and field, prime and relative prime numbers, modular arithmetic, Fermat's and Euler's theorem, primarily testing, Euclid's Algorithm, Chinese Remainder theorem, discrete logarithms, Principals of public key cryptosystems, RSA algorithm, security of RSA, key management, Diffie-Hellman key exchange algorithm, introductory idea of Elliptic curve cryptography, Elganel encryption.	08	PO2/ PO3	PSO1/ PSO2
Module-4	Message Authentication and Hash Function: Authentication requirements, authentication functions, message authentication code (MAC), hash functions, security of hash functions and MACS, MD5 message digest algorithm, Secure hash algorithm(SHA), Public Key Infrastructure(PKI): Digital Certificate, private key management, Digital Signatures: Digital Signatures, authentication protocols, digital signature standards (DSS), proof of digital signature algorithm.	08	PO3/ PO5/ PO12	PSO1/ PSO2

Module-5	Authentication Applications: Kerberos and X.509, directory authentication service, password, challenge-response, biometric authentication, electronic mail security-pretty good privacy (PGP), S/MIME.	08	PO1/ PO3	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand information security • Apply symmetric cryptography • Apply asymmetric cryptography • Implement digital signatures • Understand authentication systems
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	William Stallings, "Cryptography and Network Security: Principals and Practice", Prentice Hall, New Jersey.
2.	Atul Kahate, "Cryptography and Network Security", TMH.
3.	Behrouz A. Forouzan, "Cryptography and Network Security", TMH.
4.	Johannes A. Buchmann, "Introduction to Cryptography", Springer-Verlag. Bruce Schneier, "Applied Cryptography".

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓						✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓		✓			✓	✓	✓		✓	✓	✓

Course Code: BCE-P716
Course Name: HUMAN COMPUTER INTERACTION

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	None.
Objectives:	The course has following objectives: • Students will learn the basic physiological, perceptual, and cognitive components of human learning and memory. • Students will gain theoretical knowledge of and practical experience in the fundamental aspects of designing and implementing user interfaces. • Students will learn to analyze interaction problems from a technical, cognitive, and functional perspective. • Students will develop an awareness of the range of general human-computer interaction issues that must be considered when designing information systems.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
<i>Module-1</i>	Introduction and Interactive system design: Historical evolution of the field, Concept of usability -definition and elaboration, HCI and software engineering, GUI design and aesthetics, Prototyping techniques Model-based Design and evaluation: Basic idea introduction to different types of models, GOMS family of models (KLM and CMN-GOMS), Fitts' law and Hick- Hyman's law.	08	PO1	PSO1/ PSO2
<i>Module-2</i>	Guidelines in HCI: Shneiderman's eight golden rules, Norman's seven principles, Norman's model of interaction, Nielsen's ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry.	08	PO1/ PO2	PSO1
<i>Module-3</i>	Dialog Design: Introduction to formalism in dialog design, design using FSM (finite state machines), State charts and (classical) Petri Nets in dialog design.	08	PO2/ PO3	PSO1/ PSO2
<i>Module-4</i>	Cognitive architecture Introduction to CA, CA types, relevance of CA in IS design, Model Human Processor (MHP)	08	PO3/ PO5/ PO12	PSO1/ PSO2
<i>Module-5</i>	Object Oriented Programming: OOP- Introduction, OOM- Object Oriented Modeling of User Interface Design	08	PO1/ PO3	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Apply HCI principles • Analyze usability models • Design user-centered interfaces • Apply cognitive models • Develop accessibility systems
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Dix A., Finlay J., Abowd G. D. and Beale R. Human Computer Interaction, 3rd edition, Pearson Education, 2005.
2.	Preece J., Rogers Y., Sharp H., Baniyon D., Holland S. and Carey T. Human Computer Interaction, Addison-Wesley, 1994.
3.	Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition) Authors: Shneiderman, Plaisant, Cohen, and Jacobs Publisher: Addison Wesley; 5th edition (2009) ISBN: 978-0321537.
4.	Introduction to Human Factors Engineering (2nd Edition) Authors: Wickens, Lee, Liu, and Gordon-Becker Publisher: Pearson, 2004 ISBN-10: 0131837362
5.	Yvonne Rogers, Helen Sharp, Jennifer Preece; Interaction Design 3rd Edition Wiley 2011 <i>Useability Engineering</i> ; Morgan Kaufmann, Academic Press, London, 1993.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√										√	√	√
CO2	√	√	√									√	√	√
CO3	√	√	√										√	√
CO4	√	√						√	√	√	√	√	√	√
CO5	√	√	√	√	√	√		√	√	√		√	√	√

Course Code: BCE-P717
Course Name: BLOCKCHAIN

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	None.
Objectives:	The objective of this course is to provide conceptual understanding of block chain technology and how it can be used in Industry 4.0 The course covers the technological underpinning of block Chain operations in both theoretical and practical implementation of solutions using Ethereum.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction: Overview of Block chain, History of Blockchain, Peer to Peer Network, Smart Contract, Wallet, Digital Currency, Ledgers, Types of Blockchain Platform.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Consensus Mechanism: Permissioned Blockchain, Permissionless Blockchain , Different Consensus Mechanism- Proof of Work, Proof of Stake, Proof of Activity, Proof of Burn, Proof of Elapsed Time, Proof of Authority, Proof of Importance.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	Crypto currency and Wallet(With Practical Exercise): Types of Wallet, Desktop Wallet, App based Wallet, Browser based wallet, Metamask, Creating a account in Metamask, Use of faucet to fund wallet, transfer of cryptocurrency in metamask.	08	PO1/ PO2/ PO3/ PO5	PSO1/ PSO2
Module-4	Smart contract and Ethereum(With Practical Exercise): Overview of Ethereum, Writing Smart Contract in Solidity, Remix IDE , Different networks of ethereum, understanding blocks practically at blockhchain.com, how to compile and deploy smart contract in remix.	08	PO1/ PO2/ PO4/ PO5/ PO12	PSO1/ PSO2
Module-5	Understanding Hyperledger Fabric: Overview of Open source Hyperledger project, Hyperledger Fabric-Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric. Use Cases Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain, Blockchain in energy sector, Blockchain in governance.	08	PO1/ PO2/ PO3/ PO12	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand blockchain fundamentals • Understand cryptocurrency • Develop smart contracts • Deploy decentralized applications • Understand Hyperledger
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Bettina Warburg, Bill Wanger and Tom Serres, Basics of Blockchain (1 ed.), Independently published, 2019. ISBN 978-1089919445.
2.	Herbert Jones, Blockchain (1 ed.), CreateSpace Independent Publishing Platform, 2017. ISBN 978-1977971708.
3.	Larry A. DiMatteo, Michel Cannarsa, Cristina Poncib, The Cambridge Handbook of Smart Contracts, Blockchain Technology and Digital Platforms (1 ed.), Cambridge University Press, 2019. ISBN 978-1108492560.
4.	Antonopoulos and Andreas M., Mastering Bitcoin: unlocking digital cryptocurrencies (1 ed.), O'Reilly Media, Inc., 2015. ISBN 978-1449374044.
5.	Gaur and Nitin, Hands-On Blockchain with Hyperledger: Building decentralized applications with Hyperledger Fabric an (1 ed.), Packt Publishing Ltd, 2018. ISBN 978-1788994521

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓		✓								✓	✓
CO4	✓	✓		✓	✓			✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓					✓	✓	✓		✓	✓	✓

Course Code: BCE-P718
Course Name: DEEP LEARNING

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	Strong Knowledge of machine learning algorithms and concept, Understanding of Python Programming Concept and basic probability and statistics.
Objectives:	The course has following objectives • To understand the fundamentals and complexity of Deep Learning algorithms and their limitations. • To understand and master the basic components and tools of an intelligence system. • To explore in depth deep neural architectures for learning and inference. • To be capable of confidently applying common Deep Learning algorithms in practice and implementing their own. • To learn how to use deep learning model to solve real world problem.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
<i>Module-1</i>	Introduction to Deep Learning (DL), Applications of deep Learning, Limitations of deep learning algorithms, Artificial vs Biological Neurons, How do they learn?, Perceptron, introduction to Artificial Neural Network (ANN), Deep Neural Network, Transfer learning, Introduction to Feature Extraction vs Fine Tuning.	08	PO1/ PO2/	PSO1/ PSO2
<i>Module-2</i>	Deep Learning Tools- Python - Numpy, Pandas, Scikit-learn etc, Framework for deep learning algorithm - TensorFlow, Keras, Google Colab etc, Popular Data repositories sources for machine learning practices (UCI, Kaggle, Wikipedia, Google Dataset Search), Working with Google Colab: Uploading data, Creating Data Generators, Working with OS Module, creating Val Dir, Training using 'fit_generator', Visualizing Results.	08	PO1/ PO2/ PO3	PSO1/ PSO2
<i>Module-3</i>	Neural Networks - output vs hidden layers, Linear vs Nonlinear Networks, Activation Functions: Sigmoid, ReLU, Softmax. Loss function, Perceptron Training Rule, Multilayer Perceptron, Gradient Descent Rule. Gradient Descent and Backpropagation: Gradient Descent, Stochastic Gradient Descent, Backpropagation - recursive chain rule.	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
<i>Module-4</i>	Introduction to Convolutional Neural Networks: Kernel filter, Principles behind CNNs, Multiple Filters, CNN applications. Padding, Data Augmentation, Introduction to Recurrent Neural Networks: Introduction to RNNs, LSTM, RNN applications.	08	PO1/ PO2/ PO4/ PO12	PSO1/ PSO2
<i>Module-5</i>	Optimization and Regularization: Overfitting and Capacity, Cross Validation, Feature Selection, Regularization, Hyperparameters, dropout, batch normalization. Early stopping of training, Deep Learning	08	PO1/ PO2/ PO3/ PO12	PSO1/ PSO2

	Applications: Image Processing, Natural Language Processing, Speech Recognition, Video Analytics, Transfer Learning. Project Task - End-to-End Deep learning Model Development – Cat Vs Dog Classification.			
Total No. of Hours		40		

Learning Outcomes:	• Understand deep learning fundamentals • Use deep learning frameworks • Implement neural networks • Apply CNN and RNN • Develop deep learning applications
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Deep Learning, Second edition, Ian Goodfellow, MIT Press, 2016.
2.	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, Nicholas Locascio, O'Reilly, 2017.
3.	Machine Learning: The Art and Science of Algorithms that Make Sense of Data, Peter Flach, Cambridge University Press, 2012.
4.	Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly, 2017.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓	✓	✓			✓	✓				✓	✓
CO4	✓	✓		✓				✓	✓	✓		✓	✓	✓
CO5	✓	✓	✓					✓	✓	✓		✓	✓	✓

Course Code: BCE-P719Course Name: **FUZZY LOGIC AND NEURAL NETWORKS**

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	Fundamental of Computing.
Objectives:	The course has following objectives: • Understand Soft Computing concepts, technologies, and applications • Understand the underlying principle of soft computing with its usage in various applications. • Understand different soft computing tools to solve real life problem.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
Module-1	Introduction and Fuzzy Logic: Soft Computing definition, soft computing Vs hard computing, Applications of soft computing Techniques, Fuzzy set. Operation on Fuzzy set, fuzzy membership function, fuzzy proposition, fuzzy interferences, Fuzzy relations, application of fuzzy logics, removal of fuzziness. Neuro-Fuzzy modelling.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-2	Evolutionary Algorithms like Genetic Programming, Genetic Algorithm, Optimization of ANN using Evolutionary Algorithms, Fuzzy Logic, Member ship function, how to improve the model, diversity, training time, partitions of datasets.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-3	Statistical Reasoning: Probability and Bays' Theorem, Certainty Factors and Rule-Based Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic. AI for knowledge representation, rule-based knowledge representation, procedural and declarative knowledge, Logic programming, Forward and backward reasoning.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Module-4	Finite State Machines: Basic State Machine Model, Finite State Machine Design with Examples. Fuzzy Logic: Usage of Fuzzy Logic in Games. Basics of Fuzzy Logic, Examples of Control and Threat Assessment. Rule-Based AI: Rule-Based System Basics, Fighting Game Strike Prediction. Decisions Under Uncertainty-Bayesian Techniques: What is a Bayesian Network, Trapped and Treasure, Examples.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Module-5	Reasoning: Handling uncertainty Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. Learning Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand soft computing • Implement fuzzy logic systems • Develop neural network applications • Apply neuro-fuzzy systems • Solve real-world problems
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	F. Martin, Mcneill, and Ellen Thro, Fuzzy Logic: A Practical approach (1 ed.), AP Professional, 2000. ISBN 978-0124859654
2.	“Neural Networks in Computer Intelligence” by KM Fu, McGraw Hill (ISBN-9780136042594),1992
3.	L. Fausett, Fundamentals of Neural Networks, Prentice Hall
4.	T. Ross, Fuzzy Logic with Engineering Applications, Tata McGraw Hill

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓	✓	✓									✓	✓
CO2	✓	✓	✓	✓									✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓	✓	✓				✓	✓	✓			✓	✓
CO5	✓	✓	✓					✓	✓	✓			✓	✓

Course Code: BCE-P720

Course Name: REAL TIME OPERATING SYSTEMS

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	Concepts of Operating systems, Basics of task management and task scheduling.
Objectives:	• To acquire knowledge about concepts related to OS such as Scheduling techniques, threads, inter-thread communications, memory management. • To acquire knowledge about different types of scheduling algorithms • To study about FreeRTOS • To understand the various functions of RTOS

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
<i>Module-1</i>	Real Time Systems: Introduction to Real Time Systems, Classification of Real Time System, Concept of Computer Control, Types of Real Time Operating Systems. Requirements for Real Time Systems: Human Computer Interaction in Real Time Systems, Hardware Requirement for Real time Systems, Specialized Processors, Interfaces & Communications.	08	PO1/ PO2/	PSO1/ PSO2
<i>Module-2</i>	Real Time Operating Systems: RTOS Overview, RTOS Components, Task Management & Memory Management, Scheduling Strategies, Commercial Real-time Operating Systems. Types of multitasking, Task Scheduling, Task states, Non-Preemptive scheduling, Pre-emptive Scheduling, Round Robin Scheduling, Idle Task.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Embedded Firmware Design, development and Free RTOS Embedded Firmware Design Approaches, Super-loop based approach, Embedded Operating System based approach, Programming in Embedded C, Integrated development environment (IDE), Overview of IDEs for Embedded System Development. Introduction to FreeRTOS, Resources Used by FreeRTOS, Task Management, Task Functions, Task Priorities, Idle task and task hook function, Creation and Deletion of tasks.	08	PO1/ PO2/ PO3	PSO1/ PSO2
<i>Module-4</i>	INTER-PROCESS COMMUNICATION: Messages, Buffers, mailboxes, queues, semaphores, deadlock, priority inversion.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2

Module-5	PROCESS MANAGEMENT: Concepts, scheduling, IPC, RPC, CPU Scheduling, scheduling criteria, scheduling algorithms Threads: Multi-threading models, threading issues, thread libraries, synchronization Mutex: creating, deleting, prioritizing mutex, mutex internals.	08	PO1/ PO2/ PO3	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand RTOS concepts • Analyze scheduling algorithms • Develop embedded firmware • Implement IPC mechanisms • Manage RTOS processes
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	C.M. Krishna and G.Shin, Real Time Systems, McGraw-Hill International Edition, 1997.
2.	Jean J Labrosse, Embedded Systems Building Blocks Complete and Ready-to-use Modules in C, CMP books, 2/e, 1999.
3.	VxWorks: Programmer's Guide 5.4, Windriver, 1999
4.	Jean J Labrosse , Micro C/OS-II, The Real Time Kernel, CMP Books, 2011
5.	Sam Siewert, V, Real-Time Embedded Components and Systems: With Linux and RTOS (Engineering), 2015
6.	Tanenbaum, Modern Operating Systems, 3/e, Pearson Edition, 2007.

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	✓	✓	✓	✓									✓	✓
CO2	✓	✓											✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓	✓	✓				✓	✓	✓			✓	✓
CO5	✓	✓	✓					✓	✓	✓			✓	✓

Course Code: BCE-P721
Course Name: INTERNET OF THINGS

MM: 100 Time: 3 Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit :3
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Prerequisites:	None
Objectives:	The course has following objectives: • The Internet is evolving to connect people to physical things in real time. It's becoming the Internet of Things (IoT). • The course enables student to understand the basics of Internet of things and protocols. • It introduces some of the application areas where Internet of Things can be applied. • Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	POs mapped	PSOs mapped
<i>Module-1</i>	IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer–Security	08	PO1/ PO2/ PO3	PSO1/ PSO2
<i>Module-3</i>	IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
<i>Module-4</i>	WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
<i>Module-5</i>	IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.	08	PO1/ PO2/ PO3/ PO5/ PO6	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	• Understand IoT ecosystem • Analyze IoT protocols • Understand IoT architecture • Apply Web of Things concepts • Develop IoT applications
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press)
2.	Internet of Things: A Hands-on Approach", by Arshdeep Bahga and Vijay Madisetti (Universities Press)
3.	Internet of Things: Evolutions and Innovations By Nasreddine Bouhai
4.	Internet of Things: edited by Ovidiu Vermesan, Peter Friess
5.	Designing the Internet of Things By Adrian McEwen, Hakim Cassimally
6.	Research papers

CO-PO/PSO MAPPING														
Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√	√	√								√	√	√
CO2	√	√										√	√	√
CO3	√	√	√					√	√			√	√	√
CO4	√	√	√	√				√	√	√		√	√	√
CO5	√	√	√		√	√		√	√	√		√	√	√

Course Code: BCE- P722

Course Name: Natural Language Processing

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	● To introduce the fundamental concepts, structural levels, and linguistic challenges of Natural Language Processing. ● To master advanced text preprocessing techniques, statistical language modeling, and parsing strategies. ● To learn modern sequence labeling, lexical vector spaces, and state-of-the-art distributed embeddings. ● To evaluate and design deep learning architectures for practical applications like Machine Translation and Text Summarization.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Linguistic Background: Introduction to NLP; Industry use cases; Structural Analysis of Language: Phonology, Morphology, Syntax, Semantics, Pragmatics, and Discourse; Critical operational barriers in NLP (Ambiguity, Data Sparsity, Neologisms). The Preprocessing Pipeline: Tokenization paradigms (Word, Sentence, and Subword structures like Byte-Pair Encoding); Text Normalization pipelines; Stemming (Porter Stemmer mechanism) vs. Lemmatization; Stop-word filtering; Regular Expressions for deterministic sequence extraction; Minimum Edit Distance computation metrics.	08	PO1/ PO2/ PO5	PSO1/ PSO2
Module-2	Language Models: Principles of Language Modeling; Role and architecture of <i>N</i> -grams; Joint and Conditional probability estimations; Evaluation metrics: Perplexity computations; The Zero-Probability problem and Smoothing mechanisms (Laplace, Add-k, Good-Turing, and Kneser-Ney algorithms). Part-of-Speech (POS) Tagging: Word classes and standard Penn Treebank guidelines; Token-tag structural ambiguity; Sequence labeling frameworks; Stochastic tagging systems: Hidden Markov Models (HMM) for tagging, Viterbi decoding algorithm; Conceptual introduction to Maximum Entropy Markov Models (MEMM) and Conditional Random Fields (CRF).	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Module-3	Formal Grammars and Syntax: Context-Free Grammars (CFG) for natural English structures; Syntactic components, trees, and parsing ambiguities. Parsing Algorithms: Top-down vs. Bottom-up parsing directions; Chart Parsing paradigms; CYK (Cocke-Younger- Kasami) dynamic programming algorithm for CFG in Chomsky Normal Form; Introduction to Dependency Parsing (Transition-based vs. Graph-based parsers). Lexical Semantics: Lexical relations (Synonymy, Antonymy, Hyponymy, Polysemy); WordNet structural	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2

	hierarchy; Word Sense Disambiguation (WSD): Lesk algorithm and baseline supervised models.			
Module-4	Lexical Vector Spaces: Empirical laws of linguistics (Zipf's Law distribution); Distributional Hypothesis; Term- Document Matrix vs. Word-Context Matrix architectures; Vector proximity metrics (Cosine Similarity formulas). Weighting and Descriptors: Term Frequency-Inverse Document Frequency (TF-IDF weight formulation); Pointwise Mutual Information (PMI matrix calculations). Distributed Representations: Background of Word Embeddings; Word2Vec network architectures (Continuous Bag-of-Words - CBOW model and Skip-gram model setup); Optimization via Negative Sampling; GloVe (Global Vectors for Word Representation); Intrinsic vs. Extrinsic embedding evaluations.	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Module-5	Sequential Architectures in NLP: Recurrent Neural Networks (RNN) for sequence processing; Exploding/Vanishing gradient problems; Long Short-Term Memory (LSTM) networks and Gated Recurrent Units (GRU). Sequence-to-Sequence Models: Encoder-Decoder frameworks; The Attention Mechanism concepts (Bahdanau additive attention vs. Luong multiplicative attention); High-level breakdown of the Transformer architecture (Self- Attention components, BERT, and GPT conceptual paradigms). Applications & Evaluation Metrics: Machine Translation engineering and the BLEU validation metric; Sentiment Analysis & Text Classification pipelines (F1-score, Precision, Recall tracking); Coreference Resolution; Applied conversational metric systems for Chatbots.	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● Explain the fundamental structural levels of linguistic analysis, baseline design challenges, and core preprocessing pipelines in NLP. ● Implement and evaluate statistical Language Models (N-grams) and stochastic Part-of-Speech (POS) tagging algorithms. ● Apply context-free syntax parsers and formal lexical semantic mapping techniques to extract semantic data from text. ● Construct vector representations using matrix-based approaches (TF-IDF, PMI) a modern distributed embeddings (Word2Vec, GloVe). ● Design, optimize, and evaluate deep sequence architectures (LSTMs, Transformers) for modern generative and classification NLP deployments.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural
2.	Language Processing, Computational Linguistics, and Speech Recognition", 3rd Edition Draft.
3.	Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	√	√			√								√	√
CO2	√	√	√	√	√								√	√
CO3	√	√	√	√									√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√	√	√								√	√

Course Code: BCE- 0731**Course Name: OPTIMIZATION TECHNIQUES IN COMPUTING**

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	• Introduce the fundamental concepts of Optimization Techniques; • Make the learners aware of the importance of optimizations in real scenarios; • Provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Linear Programming: Introduction, Construction of LP Model, Graphical of Solution LP. Simplex Method, Introduction, Standard LP Form and its basic Solutions, Simplex Algorithm, Artificial Starting Solution, Special cases in Simplex Method, Applications.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Duality: Introduction, Definition of Dual Problems, Relationship between the Optimal Primal and Dual Solutions, Economic Interpretation of Duality, Dual Simplex Method, Primal Dual Computation.	08	PO1/ PO2	PSO1/ PSO2
Module-3	Integer Programming : Methods of Integer Programming, Cutting-Plane Method: Fractional (Pure Integer) Method, Mixed-Cut method, Branch and Bound Technique. . Deterministic Dynamic Programming : Introduction, Recursive Nature of Computing, Forward and Backward Recursion, Applications of Dynamic Programming in Shortest Route Problem, Cargo Loading Problem, Work Force Size Model. Subsets.	08	PO1/ PO2	PSO1/ PSO2
Module-4	Transportation and Assignment Model : Definition of Transportation Model, Non Traditional Transportation Model, Transportation Algorithms, Assignments Model. Game Theory: Minimax- Maximin criterion, Pure strategies, Mixed strategies and Expected Payoff, Concept of Dominance, Graphical Solution of $m \times 2$ and $2 \times n$ Games. Solution by Linear Programming method.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

Module-5	Queuing Theory : Definition of Queuing System, Characteristics of Queuing Models, Notation, Transient and Steady State of Queuing System, Birth-Death process, Pure birth & Pure Death processes, (M/M/1):(FIFO/ 8 / 8); (M/M/s):(FIFO/ 8 / 8); (M/M/1):(FIFO/N/8) Models, Their Characteristics, State Transition Diagrams.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● Understand the overview of optimization techniques, concepts of design space, constraint surfaces and objective function. ● Review differential calculus in finding the maxima and minima of functions of several variables. ● Solve the Linear Programming models using graphical and simplex methods. ● Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms. ● Analyze the Queuing model for effective customer satisfaction.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Engineering optimization: Theory and practice-by S.S.Rao, New Age International (P) Limited.
2.	Operations Research: An Introduction by H A Taha, 5th Edition, Macmillan, New York.
3.	Operations Research by NVR Naidu, G Rajendra, T Krishna Rao, I K International Publishing house, New Delhi.
4.	Engineering optimization: Theory and practice-by S.S.Rao, New Age International (P) Limited.

CO-PO/PSOMAPPING															
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	
CO1	✓	✓											✓	✓	
CO2	✓	✓	✓										✓	✓	
CO3	✓	✓	✓										✓	✓	
CO4	✓	✓	✓	✓	✓			✓	✓				✓	✓	
CO5	✓	✓	✓		✓			✓	✓				✓	✓	

Course Code: BCE- O732**Course Name: PARALLEL AND DISTRIBUTED SYSTEM**

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Familiarity with the design and analysis of sequential algorithms, knowledge of basic computer organization and elementary operating systems concepts are required.
Objectives:	● be able to design and analyze parallel algorithms for a variety of problems and computational models ● be familiar with the fundamentals of the architecture, operating systems, and compilers, and their performance implications in parallel computing systems. ● implement parallel applications on modern parallel computing systems, and be able to measure, tune, and report on their performance.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Introduction Parallel Computing, Parallel Architecture, Architectural Classification Scheme, Performance of Parallel Computers, Performance Metrics for Processors, Parallel Programming Models, Parallel Algorithms..	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Pipeline Processing - Introduction, Pipeline Performance, Arithmetic Pipelines, Pipelined Instruction Processing, Pipeline Stage Design, Hazards, Dynamic Instruction Scheduling. Synchronous Parallel Processing - Introduction, Example-SIMD Architecture and Programming Principles, SIMD Parallel Algorithms, Data Mapping and memory in array processors, Case studies of SIMD parallel Processor.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Introduction to Distributed Systems - Definition, Issues, Goals, Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept, Models of Middleware, Services offered by middleware, Client Server model. Communication - Layered Protocols, Remote Procedure Call, Remote Object Invocation, Message Oriented Communication, Stream Oriented Communication Resource and Process Management - Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach, Introduction to process management, process migration, Threads, Virtualization, Clients, Servers, Code Migration	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Synchronization - Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm,	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

	Requirements of Mutual Exclusion Algorithms, Performance measure, Non-Token based Algorithms: Lamport Algorithm, Ricart–Agrawala’s Algorithm, Maekawa’s Algorithm.			
Module-5	Consistency and Replication - Introduction, Data-Centric and Client-Centric Consistency Models, Replica Management. Distributed File Systems; Introduction, good features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Network File System (NFS), Andrew File System (AFS), Hadoop Distributed File System and Map Reduce.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	- Parallel Computing is concerned with the design and implementation of scalable parallel computations, i.e., a single problem solved using multiple processors operating simultaneously to decrease time to completion. Its focus is algorithms, programming models, architectures, and performance analysis. - Distributed Systems is concerned with the provision of ongoing reliable services to geographically dispersed users. The focus is networks, server architecture, protocols, security, resiliency, and scalability. - Distributed and Concurrent Algorithms is concerned with the specification and proof of safety and liveness properties of key algorithms used in concurrent systems such as mutual exclusion. Its focus is the application of formal techniques. - Analyze synchronization and coordination algorithms. - Design distributed applications using IPC techniques.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	A Grama, A Gupta, G Karypis, V Kumar. Introduction to Parallel Computing (2nd ed.). Addison Wesley, 2003.
2.	C Lin, L Snyder. Principles of Parallel Programming. USA: Addison-Wesley Publishing Company, 20 .
3.	J Jeffers, J Reinders. Intel Xeon Phi Coprocessor High-Performance Programming. Morgan Kaufmann Publishing and Elsevier, 2013.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√			√					√	√
CO5	√	√	√		√			√					√	√

Course Code: BCE- O733**Course Name: AD-HOC & SENSOR NETWORKS**

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	● To analyze the various design issues and challenges in the layered architecture of Ad hoc wireless networks ● To compare the differences between cellular and ad hoc networks and analyze the challenges at various layers and applications ● To summarize the protocols used at the MAC layer and scheduling mechanisms ● To compare and analyze types of routing protocols used for unicast and multicast routing ● To examine the network security solution and routing mechanism ● To examine the quality of service routing in Ad-hoc Networks.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	INTRODUCTION: Introduction to ad-hoc networks – definition, characteristics, features, Applications. Characteristics of wireless channel, ad-hoc mobility models: indoor and outdoor models.	08	PO1/ PO2	PSO1/ PSO2
Module-2	MEDIUM ACCESS PROTOCOLS: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.	08	PO1/ PO2	PSO1/ PSO2
Module-3	NETWORK PROTOCOLS: Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.	08	PO1/ PO2	PSO1/ PSO2
Module-4	END – END DELIVERY AND SECURITY: Transport Layer: Issues in designing – Transport layer classification, adhoc transport protocols. Security issues in adhoc networks: issues and challenges, network security attacks, secure routing protocols.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2
Module-5	CROSS LAYER DESIGN: Cross layer Design: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of ad hoc with Mobile IP networks.	08	PO1/ PO2	PSO1/ PSO2

Total No.of Hours	40		
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Learning Outcomes:	● Describe the unique issues in ad-hoc/sensor networks. ● Describe current technology trends for the implementation and deployment of wireless ad-hoc/sensor networks. ● Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc/sensor networks. ● Discuss the challenges in designing routing and transport protocols for wireless Ad-hoc/sensor networks. ● Comprehend the various sensor network Platforms, tools and applications.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols, 2nd edition, Pearson Edition, 2007.
2.	Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.
3.	Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-hoc networking, Wiley-IEEE press, 2004.
4.	Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
5.	T. Camp, J. Boleng, and V. Davies “ A Survey of Mobility Models for Ad-hoc Network”

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓	✓	✓	✓								✓	✓
CO5	✓	✓	✓		✓			✓	✓	✓			✓	✓

Course Code: BCE- O734**Course Name: BIO MEDICAL SIGNAL PROCESSING**

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Basic Knowledge of Medical Background
Objectives:	This course introduces basic requirement for instrumentation of human body, data acquisition and monitoring. The student will understand various biomedical signals and image applications of ECG, EEG, EMG etc.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Introduction to Bio-Medical Instrumentation: Components of the man-instrumentation system, Physiological systems of the body, Problems encountered in measuring a living system, Basics of Electrocardiography, Electroencephalography & Electromyography, Transducer and transducer principles, active transducer, passive transducer, transducer for biomedical applications, Resting and active potentials, Propagation of action potentials.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Role of Computers in the Analysis, Processing, Monitoring & Control and image reconstruction in bio-medical field, Temperature Measurements, Principles of ultrasonic measurement, Instrumentation for Diagnostic X Rays. Electrical safety in medical equipment: Physiological effects of electrical current, shock hazards from electrical equipment, methods of accident prevention.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	ECG: ECG data acquisition, ECG lead system, Removal of Baseline Wander and Power Line Interferences, ECG parameters and their estimation: QRS Detection (Different Methods), Estimation of R-R Interval, ST Segment Analysis, Arrhythmia Analysis	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Data Reduction: Turning Point algorithm, AZTEC Algorithm, Fan Algorithm, Huffman and Modified Huffman Coding, Run Length Coding.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2
<i>Module-5</i>	EEG: Neurological Signal Processing, The electrophysiological origin of brain waves, The EEG signals & characteristic, linear prediction theory, the autoregressive method, spectral error measure, Transient detection and estimation – the case of epileptic patients, Sleep EEG, markov	08	PO1/ PO2	PSO1/ PSO2

	model and markov chain, Dynamics of Sleep/Wake transition. Course Outcome: Student will learn how to interface human body for data monitoring and acquisition. It will provide design guideline for biomedical instrumentation.			
Total No.of Hours		40		

Learning Outcomes:	• develop a strong understanding of the biomedical engineering and how it can be applied for medical purpose to treat problems in diseases. • learn to research and understand the unique needs of specific challenges in biomedical engineering. • learn to build knowledge about different problems in biomedical engineering. • learn to develop and test innovative ideas through a deep knowledge of biomedical engineering • develop the willingness to take a risk and the ability to deal with failure.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Biomedical Instrumentation and Measurement.,Crommwell,Weibel and Pfeifer, PHI
2.	Biomedical Signal Analysis A Case Study Approach, Rangaraj M. Rangayyan, John Wiley and Sons Inc.
3.	Medical instrumentation Application and Design, john G. Webster, john Wiley & Sons Inc.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√			√	√	√			√	√
CO5	√	√	√		√								√	√

Course Code: BCE- O735

Course Name: E-COMMERCE

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	● Identify and apply relevant problem solving methodologies ● Design components, systems and/or processes to meet required specifications for a web presence ● Demonstrate research skills ● Communicate effectively in ways appropriate to the discipline, audience and purpose. ● Work as an effective member or leader of diverse teams within a multi-level, multi-disciplinary and multi-cultural setting for the Group Website Research Project ● Appreciate ethical implications of professional practice

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Electronic Commerce: Frameworks, E-Commerce and Convergence, Anatomy of E-Commerce Applications, Consumer Applications, Organization Applications. Network Infrastructure for E-Commerce: Market forces influencing, Components of I-Way, Network Access Equipment, Global Information Distribution Network. Internet as Network Infrastructure: Internet Terminology, History of Internet, NSFNET, National Research and Educational Network, Globalization of Academic Internet, Internet Applications.	08	PO1/ PO2	PSO1/ PSO2
Module-2	E-Commerce and WWW: Architectural Framework of E-Commerce, WWW as the Architecture, Hypertext Publishing, Technology and Security of Web. Consumer Oriented E-Commerce: Consumer Oriented Application, Mercantile Process Model, Mercantile Model from consumer and Merchant's Perspective. Electronic Payment System: Types of EPS, Digital Token-Based EPS, Smart Cards and EPS,	08	PO1/ PO2	PSO1/ PSO2

	Credit card based EPS, Risk and EPS, Designing EPS.			
Module-3	Inter Organizational Commerce and EDI: EDI, EDI Applications in Business, EDI : Legal, Security and Privacy Issue, EDI and E-Commerce, Standardization and EDI, EDI Software implementation, EDI Envelop for Message Transport, Value Added Networks, Internet Based EDIs. Intra Organizational E-Commerce: Internal Information System, Macro Forces and Internal Commerce, Work-Flow Automation and Coordination, Customization and Internal Commerce.	08	PO1/ PO2	PSO1/ PSO2
Module-4	Supply Chain Management: SCM Fundamentals, Managing Retail Supply Chain, Supply Chain Application Software, Future of Supply Chain Software E-Commerce and Banking: Changing Dynamics in Banking industry, Home Banking History and Implementation Approaches, Open Versus Closed Models, Management Issues in Online Banking. Network Security and Firewalls: Client-Server Network Security, Emerging Client Server Security Threats, Firewalls and Network Security, Data and Message Security, Challenge Response System, Encrypted Documents and E-Mail.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2
Module-5	Advertising and Marketing on the Internet: Information based Marketing, Advertising on Internet, Charting on-Line Marketing Process. Consumer Search and Resource Discovery: Search and Resource Discovery Paradigms, Information Search and retrieval, E-Commerce Catalogs, Information Filtering, Consumer-Data Interface. Software Agents: History, Characteristics and Properties of Software Agents, Technology behind Software Agents, Telescript Agent Language, Safe-Tcl, Applets, Browser and Software Agents.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● Understand the E-Commerce and E- business infrastructure and trends ● Analyze different types of portal technologies and deployment methodologies commonly used in the industry. ● Analyze the effectiveness of network computing and cloud computing policies in a multi- location organization. ● Analyze real business cases regarding their e-business strategies and transformation processes and choices. ● Integrate theoretical frameworks with business strategies.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Ravi Kalokaota and A.B. Whinston, Frontiers of Electronic Commerce, Addison-Wesley
2.	Ravi Kalokaota and A.B. Whinston, Electronic Commerce A Manager's Guide, Addison-Wesley
3.	E-Business Roadmap for Success Dr. Ravi Kalakota Marcia Robinson Addison Wesley

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√		√			√	√	√			√	√

Course Code: BCE- O736

Course Name: HUMAN RESOURCE AND ORGANIZATION BEHAVIOUR

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	● To learn the basics of Human Resource and Organizational Behavior. ● The course shall be conducted in an interactive manner since students learn best by active participation. ● To explain the use of Human Resource and Organizational Behavior in current job scenario. ● To practical knowledge of Human Resource and Organizational Behavior. ● To learn what is the use of Industrial Economics and Business Administration in practical life and business. ● Students develop basic skills for the job market. ● Lecture and discussion methods will be followed to familiarize students with the theories, concepts, techniques, etc. ● Provide an authentic opportunity for students to develop teamwork and leadership skills.
NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.

Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Introduction: What is Organizational Behaviour (OB) and Human Resource Management (HRM) Difference between corporates and development organizations OB and HRM and Sustainable development OB and HRM: contribution and linkages with sustainability Importance of OB and HRM for sustainable development practitioners.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Knowing and Managing Yourself: Individual Behaviour: MARS model of individual behaviour Values: Values across cultures (Hofstede's framework); Personality: Big five model; MBTI; Use of personality tests; Personality attributes influencing OB Emotions: Understanding emotions; Emotional labour; Emotional Intelligence Attitudes: Attitudes v/s values; Job Satisfaction.	08	PO1/ PO2	PSO1/ PSO2
Module-3	Motivation in the workplace: What is motivation; Early theories of motivation; Contemporary theories of motivation; Designing motivating jobs: JCM model; motivation of social workers. Coordination, Customization and Internal Commerce.	08	PO1/ PO2	PSO1/ PSO2

Module-4	Communication: What is communication; Organizational communication: Formal networks and Grapevine; Electronic communications; Barriers to effective communication; non- verbal communication; Improving Interpersonal. communication: Empathy and Active listening	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2
Module-5	Leadership: Difference between managers and leaders; Perspectives of leadership: Trait, Behavioural, Contingency; Inspirational leadership: Transactional, Transformational, Charismatic; NGO leadership Job Analysis: Job description; Job Specification; Job Evaluation.	08	PO1/ PO2	PSO1/ PSO2
Total No. of Hours		40		

Learning Outcomes:	- Develop a strong understanding of the Industrial Economics and Business Administration and how it can be applied for business purpose to treat problems in diseases. - In today's dynamic environment, where technology and capital have ceased to provide competitive advantage, it is only an organization's human resources which have become the differentiating factor for organizational success and excellence. - OB provides perspectives and skills that enhance understanding of our own behavior and our ability to influence the behavior of others in organizational settings. - Explain individual behaviour in organizations. - Analyze organizational challenges and employee attitudes.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2.	McShane: Organizational Behaviour, 3e, TMH, 2008
3.	Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4.	Newstrom W. John & Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5.	P. Jyothi, P. and Venkatesh, D.N., Human Resource Management, New Delhi, Oxford University Press.

CO-PO/PSOMAPPING															
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	
CO1	√	√											√	√	
CO2	√	√	√										√	√	
CO3	√	√	√						√				√	√	
CO4	√	√	√	√	√				√				√	√	
CO5	√	√	√		√			√	√	√			√	√	

Course Code: BCE- O737

Course Name: SOFT COMPUTING

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Strong Knowledge of Mathematics, Algorithmic concept, Understanding of Programming and basic problem-solving skills.
Objectives:	● To understand Soft Computing concepts, technologies, and applications. ● To understand the underlying principle of soft computing with its usage in various applications. ● To understand different soft computing tools to solve real life problems. ● To understand basic Fuzzy System and Genetic Algorithms and their use cases.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Overview of Soft Computing, Difference between Soft and Hard computing, Requirement and components of Soft computing including Artificial intelligence systems Neural networks, fuzzy logic, genetic algorithms, Artificial neural networks Vs Biological neural networks, Major Areas of Soft Computing, Applications of Soft Computing.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Introduction and how brain works, Neuron as a simple computing element, Introduction of Neural Network, Learning rules and various activation functions, Single layer Perceptron, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Backpropagation Learning, Introduction to Early ANN architectures (basics only)-McCulloch & Pitts model, Perceptron, Adaline, Madaline.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Hebbian Learning, Competitive learning, Introduction to Fuzzy Set theory, Fuzzy versus Crisp set, Fuzzy Relation, Fuzzification, Minmax composition, Defuzzification Method, Fuzzy Logic, Fuzzy Rule based systems, Predicate logic, Fuzzy Decision Making, Fuzzy Classification.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators- Reproduction, Crossover, Mutation, Boltzmann, tournament, rank, and steady state selections, Convergence of	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

	GA, Bit wise operation in GA, Multi-level Optimization. Applications of GA and Introduction to genetic programming- basic concepts.			
Module-5	GA based Weight Determination, K - factor determination in Columns. Fuzzy BP Architecture, Learning in Fuzzy BP, Application of Fuzzy BP Networks, Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● To get a glimpse of Fuzzy logic and its applications. ● Understand Artificial neural networks and its applications. ● Solve single-objective optimization problems using GAs. ● Develop applications on different soft computing techniques like Fuzzy, GA and Neural networks. ● Implement Neuro-Fuzzy and Neuro-Fuzz-GA expert systems.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Fuzzy Logic with Engineering Applications (3rd Edn.), Timothy J. Ross, Willey, 2010.
2.	An Introduction to Genetic Algorithms, Melanie Mitchell, MIT Press, 2000.
3.	Genetic Algorithms In Search, Optimization And Machine Learning, David E. Goldberg, Pearson Education, 2002.
4.	Neural Networks, Fuzzy Logis and Genetic Algorithms: Synthesis, and Applications, S. Rajasekaran, and G. A. Vijayalakshmi Pai, Prentice Hall of India, 2007.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓					✓	✓	✓			✓	✓
CO4	✓	✓	✓	✓	✓				✓				✓	✓
CO5	✓	✓	✓		✓				✓				✓	✓

Course Code: BCE- O738**Course Name: STORAGE MANAGEMENT**

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	• To understand the basic components of Storage System Environment. • To understand the Storage Area Network Characteristics and Components. • To describe the different backup and recovery topologies and their role in providing disaster recovery and business continuity capabilities. • To understand the local and remote replication technologies.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Introduction to Storage Technology: Data proliferation, evolution of various storage technologies, Overview of storage infrastructure components, Information Lifecycle Management, Data categorization.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Storage Systems Architecture: Intelligent disk subsystems overview, Contrast of integrated vs. modular arrays, Component architecture of intelligent disk subsystems, Disk physical structure components, properties, performance, and specifications, RAID levels & parity algorithms, hot sparing, Front end to host storage provisioning, mapping and operation.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Introduction to Networked Storage: JBOD, DAS, NAS, SAN & CAS evolution and comparison. Applications, Elements, connectivity, standards, management, security and limitations of DAS, NAS, CAS & SAN.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Hybrid Storage solutions; Virtualization: Memory, network, server, storage & appliances. Data center concepts & requirements, Backup & Disaster Recovery: Principles Managing & Monitoring: Industry management standards (SNMP, SMI-S, CIM), standard framework applications, Key management metrics (Thresholds, availability, capacity, security, performance).	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

<i>Module-5</i>	Information storage on cloud :Concept of Cloud, Cloud Computing, storage on Cloud, Cloud Vocabulary, Architectural Framework, Cloud benefits, Cloud computing Evolution, Applications & services on cloud, Cloud service providers and Models, Essential characteristics of cloud computing, Cloud Security and integration.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● Understand the logical and physical components of a Storage infrastructure. ● Evaluate storage architectures, including storage subsystems, DAS, SAN, NAS, and CAS. ● Understand the various forms and types of Storage Virtualization. ● Describe the different role in providing disaster recovery and business continuity capabilities. ● Distinguish different remote replication technologies.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Nick Antonopoulos, Lee Gillam; Cloud Computing : Principles, System & Application, Springer.
2.	Anthony T. Velete, Toby J.Velk, and Robert Eltenpeter, Cloud Computing : A practical approach,TMH Pub.
3.	Saurabh , Cloud Computing : Insight into New Era Infrastructure, Wiley India.
4.	Rich Schiesser, IT Systems Management :Designing, Implementing and Managing World-classInfrastructures, PHI Learning

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√		√			√	√	√			√	√

Course Code: BCE- O739

Course Name: QUANTUM COMPUTING

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Strong Knowledge of Physics & Mathematics and Basic Algorithmic Concept.
Objectives:	• To introduce the fundamentals of quantum computing. • The problem solving approach using finite dimensional mathematics. • Explain the key principles of the various models of quantum computation.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Introduction to Quantum Computation: Qubits versus classical bits, spin-half systems and photon polarizations, Bloch sphere representation of a qubit, multiple qubits. Foundations of quantum theory. States, observables, measurement and unitary evolution, Pure and mixed states, density matrices.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Background Mathematics and Physics: Hilbert space, Probabilities and measurements, entanglement, density operators and correlation, basics of quantum mechanics, Measurements in bases other than computational basis..	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Quantum Circuits: single qubit gates, multiple qubit gates, design of quantum Circuits. Deutsch's Algorithm, Simon's periodicity algorithm, Grover's search algorithm.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Quantum Information and Cryptography: Comparison between classical and quantum information theory. Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

Learning Outcomes:	• Basics of complex vector spaces. • Architecture and algorithms. • Quantum mechanics as applied in Quantum computing. • Fundamentals of Quantum computations. • Compare classical and quantum computing paradigms
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Module-5	Quantum Algorithms: Classical computation on quantum computers. Relationship between quantum and classical complexity classes. Deutsch's algorithm, Deutsch's-Jozsa algorithm, Shor factorization, Grover search.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Paul Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press (2007).
2.	Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press.
3.	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific.
4.	Pittenger A. O., An Introduction to Quantum Computing Algorithms.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√				√	√					√	√
CO4	√	√	√	√	√		√	√					√	√
CO5	√	√	√		√		√	√					√	√

Course Code: BCE- O740

Course Name: COMPUTER VISION

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Basic Knowledge of probability & linear algebra and basic programming & algorithmic Concept.
Objectives:	• To introduce the fundamentals of computer vision. • Basic principles of image formation, image processing algorithms and different algorithms for 3D reconstruction and recognition from single or multiple images (video). • Real world use cases of computer vision.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Image Formation Models: Monocular imaging system, Orthographic & Perspective Projection, Cameras – lenses, projections, sensors, Radiometry –Measuring Light, light and surfaces Representation – color spaces, Camera model and Camera calibration, Binocular imaging systems, Sources, Shadows and Shading.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	2D/3D Vision: Filters, Binary Images, Features, Edge Detection, Texture, Shape, Segmentation, Clustering, Model Fitting, Probabilistic, 3D Vision: Multiview geometry, Stereo, Shape from X,3D data.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Image Processing and Feature Extraction: Image representations (continuous and discrete), Linear Filters, Texture, Edge detection. Motion Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Structure from motion.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi resolution analysis.	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

Module-5	Object recognition: Hough transforms and other simple object recognition methods, Shape correspondence and shape matching, Principal Component analysis, Shape priors for recognition.	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	- Understand key features of Computer Vision to analyze and interpret the visible world around us. - Design and implement multidimensional signal processing, feature extraction, pattern analysis, visual geometric modeling, and stochastic optimization. - Apply the computer vision concepts to Real World Problems (Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc.). - Apply image preprocessing and enhancement techniques. - Analyze image features using edge detection methods.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Computer Vision: A Modern Approach by D. A. Forsyth and J. Ponce, Prentice Hall, 2003.
2.	Computer Vision by Linda Shapiro and George Stockman, Prentice-Hall, 2001.
3.	Robot Vision, by B. K. P. Horn, McGraw-Hill. 1986.
4.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√				√	√					√	√
CO4	√	√	√	√	√		√	√					√	√
CO5	√	√	√		√		√	√					√	√

Course Code: BCE- 0741

Course Name: AI IN HEALTHCARE

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	Basic Knowledge of probability & linear algebra and basic programming & algorithmic Concept.
Objectives:	• Understand models of human and artificial intelligence, specifically computational models of Intelligence. • Comprehend a collection of machine learning models (identified and covered in the course), and their applications in medicine and healthcare. • Analyze the performance of specific models as applied to biomedical problems, and justify their use and limitations.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
<i>Module-1</i>	Introduction to AI in Healthcare, Why AI is needed in Healthcare, Examples of AI in Healthcare and Growth of AI in Healthcare, Operationalizing Consumerism Using AI, Operationalizing a New Supply Chain, Machine Learning, Artificial Intelligence and Decision Support.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-2</i>	Review of relevant mathematical and statistical concepts: logarithmic loss, cross entropy optimizing cost functions; linear and logistic regression. Forms of Learning: supervised, semi-supervised, unsupervised, active, and transfer learning.	08	PO1/ PO2	PSO1/ PSO2
<i>Module-3</i>	Supervised Learning: Decision trees, non-parametric methods for learning, support vector machines, Bio-inspired learning (from perceptron to deep learning): neural basis of computing, classical neural networks, deep neural networks, deep belief networks, recurrent neural networks, and convolutional neural networks. Unsupervised Learning: basic and advanced clustering techniques, dimensionality reduction (feature selection and feature extraction)	08	PO1/ PO2	PSO1/ PSO2
<i>Module-4</i>	Knowledge Representation and Reasoning: Propositional logic, first-order logic, ontological engineering and probabilistic reasoning, Time-	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

	series analysis: temporal models (probabilistic reasoning over time).			
Module-5	Unique characteristics and challenges in medicine and healthcare; History and status quo of intelligent and expert systems in medicine. Risk stratification, patient outcome prediction, disease progression modeling, Clinical decision-making and intelligent systems to support evidence-based medicine, Phenotype and clinical/bio-marker discovery, Relevance to personalized medicine. Analysis of tissue morphology and other medical imaging applications	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	On completion of course, student will learn: Determine the factors involved in decision support that can improve business performance across the provider/payer ecosystem. Identify differences in methods and techniques in order to appropriately apply to pain points using case studies. Critically assess the opportunities to leverage decision support in adapting to trends in the industry. Explain applications of AI in healthcare systems.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Prashant Natarajan, John C. Frenzel, and Detlev H. Smaltz, Demystifying Big Data and Machine Learning for Healthcare (1 ed.), CRC Press, 2017. ISBN 9781138032637.
2.	Arjun Panesar, Machine Learning and AI for Healthcare: Big Data for Improved Health Outcomes (1 ed.), Apress, 2019. ISBN 978-1484237984.
3.	Raghupathi W, Raghupathi V., Big data analytics in healthcare: promise and potential, Health info science and syst.,2014.
4.	Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	√	√											√	√
CO2	√	√	√										√	√
CO3	√	√	√										√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√		√		√	√	√	√			√	√

Course Code: BCE- O742

Course Name: NEURAL NETWORK AND DEEP LEARNING

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Introduction: What is a neural network, Supervised Learning with Neural Networks, What is Deep Learning, Why is Deep Learning taking off.	08	PO1/ PO2	PSO1/ PSO2
Module-2	Neural Networks Basics: Binary Classification, Logistic Regression, Logistic Regression Cost Function, Gradient Descent, Derivatives. Computation graph, Derivatives with a Computation Graph, Logistic Regression Gradient Descent, Gradient Descent on m Example, Vectorization, Vectorising Logistic Regression, Vectorising Logistic Regression's Gradient Output, Broadcasting in Python	08	PO1/ PO2	PSO1/ PSO2
Module-3	Shallow neural networks: Neural Networks Overview, Neural Network Representation, Computing a Neural Network's Output, Vectorizing across multiple examples, Explanation for Vectorized Implementation, Activation functions, Why do you need non-linear activation functions?, Derivatives of activation functions, Gradient descent for Neural Networks, Backpropagation intuition (optional), Random Initialization	08	PO1/ PO2	PSO1/ PSO2
Module-4	Deep Neural Networks: Deep L-layer neural network, Forward Propagation in a Deep Network, Getting your matrix dimensions right, Why deep representations?, Building blocks of	08	PO1/ PO2/PO 3/PO 4	PSO1/ PSO2

	deep neural networks, Forward and Backward Propagation, Parameters vs Hyper parameters			
Module-5	Case Study: Learning from Scientist: Geoffrey Hinton, Pieter Abbeel, Ian Goodfellow, Yuanqing Lin, etc	08	PO1/ PO2	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	- Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains. - Implement deep learning algorithms and solve real-world problems. - Understand the basics of neural networks. - Explain perceptron and multilayer neural networks. - Apply backpropagation for training neural models.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	CharuC.Aggarwal “Neural Networks and Deep learning” Springer International Publishing, 2018
2.	Satish Kumar, “Neural Networks, A Classroom Approach”, Tata McGraw -Hill, 2007.
3.	Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.
4.	Duda, Richard, Peter Hart, and David Stork. Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000.

CO-PO/PSOMAPPING														
Course Outcomes (COs)	Program Outcomes(POs)												Program Specific Outcomes (PSOs)	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	✓	✓											✓	✓
CO2	✓	✓	✓										✓	✓
CO3	✓	✓	✓										✓	✓
CO4	✓	✓	✓	✓	✓								✓	✓
CO5	✓	✓	✓		✓		✓	✓	✓	✓			✓	✓

Course Code: BCE- O743

Course Name: Biometric and Fingerprint Recognition

MM:100 Time:3Hr. L T P 3 0 0	Sessional:30 ESE:70 Credit:3
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Prerequisites:	None
Objectives:	● To understand the fundamental concepts, components, and evaluation parameters of biometric systems. ● To master the biological physiology, acquisition, feature extraction, and classification of fingerprints. ● To learn automated fingerprint matching techniques (AFIS) and secondary physiological/behavioral modalities. ● To analyze vulnerabilities, spoofing attacks, security metrics, and multimodal fusion strategies in deployment.

NOTE:	The question paper shall consist of two sections A and B. Section A contains 10 short type questions of 6 marks each and student shall be required to attempt any five questions. Section B contains 8 long type questions of ten marks each and student shall be required to attempt any four questions. Questions shall be uniformly distributed from the entire syllabus.
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Module	Course Content	No. of Hours	Pos mapped	PSOs mapped
Module-1	Concepts of Biometric Recognition: History and evolution; Benefits of biometrics over traditional credentials(passwords, tokens); Logical vs. physical access control; Verification vs. Identification paradigms (1:1 matching vs. 1:N search). System Performance Metrics: False Match Rate (FMR/FAR), False Non-Match Rate (FNMR/FRR), Receiver Operating Characteristic (ROC) curve, Detection Error Trade-off (DET) curve, Equal Error Rate (EER), Failure to Enroll (FTE), and Failure to Acquire (FTA). Design Cycle: Basic building blocks of an automated biometric infrastructure (Capture, Pre-processing, Feature Extraction, Template Generation, Matching Database).	08	PO1/ PO2/ PO5	PSO1/ PSO2
Module-2	Biological formation of friction ridges; History of fingerprinting in forensics (Galton points and Henry Classification System). Pattern Classification: Loops (Radial/Ulnar), Whorls (Plain, Central Pocket, Double Loop, Accidental), and Arches (Plain/Tented); Core and Delta singularity point detection. Minutiae & Features: Level 1 (Global pattern flow), Level 2 (Minutiae: ridge endings, bifurcations, islands, dots), and Level 3 (Pores, ridge dimensional deviations).	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2

Module-3	Digital step-by-step pipeline of AFIS; Image Enhancement techniques (Gabor filtering, Histogram equalization, Binarization); Ridge Thinning and Skeletonization processes. Feature Extraction: Minutiae extraction algorithms, Crossing Number (CN) concept, and elimination of false minutiae / boundary artifacts. Matching Algorithms: Minutiae-based matching (point pattern alignment), Ridge feature-guided structural matching, and global Correlation-based matching.	08	PO1/ PO2/ PO3/ PO4	PSO1/ PSO2
Module-4	Iris & Retina Scan: Anatomy of the eye; Iris image acquisition, Daugman's integro-differential operator for segmentation, normalization (pseudo-polar rubber sheet model), IrisCode generation via 2D Gabor filters. Retina vascular structure tracking. Face Recognition: Image acquisition and normalization; Geometric vs. Statistical learning approaches; Subspace projection methods: Principal Component Analysis (Eigenfaces), Linear Discriminant Analysis (Fisherfaces). Behavioral Modalities: Voice/Speaker recognition (Mel-Frequency Cepstral Coefficients - MFCC feature extraction), Dynamic Signature Verification, and Keystroke Dynamics.	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Module-5	Multimodal Systems: Fundamental limitations of unimodal systems (noise, distinctiveness, non-universality, spoofing); Architectural configurations (Multi-sensor, multi-algorithmic, multi-instance, and multimodal). Fusion Levels: Fusion at the Data/Sensor level, Feature level, Score level (Normalization techniques: Min-Max, Zscore, Sigmoid), and Decision level. Biometric Security & Privacy: Vulnerabilities (Spoofing, Replay attacks, Database tampering); Presentation Attack Detection (PAD) / Liveness detection; Biometric Template Protection (Cancelable biometrics and Fuzzy commitment/vaults); Cryptographic key generation; Privacy implications.	08	PO1/ PO2/ PO3/ PO4/ PO5	PSO1/ PSO2
Total No.of Hours		40		

Learning Outcomes:	● Explain the key concepts, design cycles, and performance metrics (FAR, FRR, EER) of basic biometric architectures. ● Classify fingerprint patterns, locate ridge minutiae, and describe the internal mechanics of Automated Fingerprint Identification Systems (AFIS). ● Compare alternate physiological (Iris, Face, Retina) and behavioral (Voice, Signature) biometric systems. ● Evaluate multimodal biometric systems using distinct information-fusion levels and score normalization techniques. ● Identify vulnerabilities in biometric deployments, such as presentation attacks, and recommend cryptographic or liveness-detection countermeasures.
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Suggested books:

S.No.	Name of Authors/Books/Publisher/Year
1.	Anil K. Jain, Arun A. Ross, and Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011.
2.	Davide Maltoni, Dario Maio, Anil K. Jain, and Salil Prabhakar, "Handbook of Fingerprint Recognition", 2 nd Edition, Springer, 2009.
3.	G.R. Sinha and Sandeep B. Patil, "Biometrics: Concepts and Applications", Wiley India, 2013.

CO-PO/PSOMAPPING														
Course Outcome s (COs)	Program Outcomes(POs)												Program Specific Outcome s (PSOs)	
	P O 1	P O 2	P O 3	P O 4	P O 5	P O 6	P O 7	P O 8	P O 9	PO 10	PO 11	PO 12	PS O 1	PS O 2
CO1	√	√			√								√	√
CO2	√	√	√	√	√								√	√
CO3	√	√	√	√									√	√
CO4	√	√	√	√	√								√	√
CO5	√	√	√	√	√								√	√

GURUKULA KANGRI VISHWAVIDYALAYA (Deemed to be University), HARIDWAR
Faculty of Engineering & Technology Computer Science & Engineering
B. Tech. Fourth Year
Syllabus in accordance with AICTE Model Curriculum
SEMESTER-VIII

DSC/SEC/DSE/ AEC	SUBJECT	PERIODS			EVALUATION SCHEME				Subject Total	Credits	
					SESSIONAL EVALUATION			EXA M ESE			
		L	T	P	CT	TA	Total				
THEORY											
BCE-O8XX	MOOC- I	3	1	0	20	10	30	70	100	4	
BCE-O8XX	MOOC- II	3	1	0	20	10	30	70	100	4	
BCE-O8XX	MOOC- III	3	1	0	20	10	30	70	100	4	
PRACTICAL											
BCE-P861	Major Project with Research paper	0	0	16	0	100	100	300	400	9	
TOTAL		9	3	16	60	130	190	510	700	21	

List of MOOC courses shall be decided by the departmental committee in each semester depending upon the list from SWAYAM/NPTEL and other recognized online platforms. Students have to study from Online Platform doubt sessions shall be held by Internal teachers and exams shall be taken by university. If a student wishes he can give exam of Online Platform for certification. SWAYAM courses to run every year from July onwards (Odd Semester) are declared in the month of May and for courses to run every year from January onwards(Even Semester) are declared in the month of December on website <https://swayam.gov.in/>.

Course Code: BCE-P861

**Course Name: MAJOR PROJECT WITH
RESEARCH PAPER**

MM: 400 Time: 8 Hr. L T P 0 0 16	Sessional: 100 ESE: 300 Credit: 09
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Objectives:	1. Study and identify the problem area by studying and reviewing research papers. 2. Implement the skills of software engineering and software project management. 3. Improve upon the communication and presentation skills.
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NOTE:	Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination. There shall be a seminar on the project work of the student to be evaluated by the Departmental committee chaired by H.O.D.
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PROJECT DETAILS	No. of Hours	POs mapped	PSOs mapped
Each student shall be assigned a Major Project by departmental committee. The student is required to perform his project work under the supervision of the supervisor(s). There shall be a presentation on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student is required to submit his project report along with a research paper in the form of dissertation 15 days before the end of VIII semester. The student is required to submit three copies of the project work with a certificate from the supervisor(s) that the work is an authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.	03	PO1/ PO2/ PO3/ PO4/ PO5/ PO9/ PO10/ PO11/ PO12	PSO1/ PSO2

Learning Outcomes:	• Students will get knowledge of problem identification and use their skills for team building and project development. • develop a solution for any real world problem. • Students will get equipped with knowledge of latest/upcoming problems and solutions. • Students will also be able to improve skills for project planning, implementation and communication. • Enhance communication, technical writing, presentation, and research documentation skills through seminars, reports, and viva-voce examinations.
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Suggested books:

S. No.	Name of Authors /Books /Publisher/Year
1.	Ford, Neal, Matthew McCullough and Nathaniel Schutta, Presentation patterns:Techniques for crafting better presentations (1 ed.), Addison- Wesley, 2012. ISBN 978-0321820808.

CO-PO/PSO MAPPING

Course Outcomes (COs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	√	√											√	√
CO2	√	√	√						√	√	√		√	√
CO3	√	√	√	√	√				√	√	√	√	√	√
CO4	√	√		√	√				√	√	√	√	√	√
CO5	√	√	√	√	√				√	√	√	√	√	√