SAGE UNIVERSITY, BHOPAL

(SANJEEV AGRAWAL GLOBAL EDUCATIONAL UNIVERSITY, BHOPAL)

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SYLLABUS

PhD COURSE WORK

SESSION-2020-2021

PhD PROGRAM

Program Educational Objectives (PEOs)

The Program PhDwill develop ability to identify and solve the real-world problems related to various areas of Research. It will also develop an aptitude to apply the observations and in-depth knowledge of various research areas. The course will:

PEO I: Professionally utilize fundamental knowledge, analytical and problem-solving skills to articulate and make decisions critically and creatively based on researchevidences and experiences in professionalpractice.

PEO II: Competently provide solutions for the advancement of knowledge through the application of appropriate tools and techniques

PEO III: Continue to acquire advanced knowledge in pursuing lifelong learning anddisplay commitment to the community andprofession through effective communication withpeers by adhering to legal, ethical, andprofessional codes of practice.

PEO IV: Synthesize knowledge andcontribute tooriginal researchthat broadensthe frontier ofknowledge in therelevant field.

PEO V: Conduct research independently and adheres to legal, ethical and professional codes of practice.

PROGRAMME OUTCOMES (POs):

PO1.	Demonstrate an in-depthscholarship of their area ofresearch
PO2.	Contribute to original research tobroaden the boundary ofknowledge through thesis or dissertation
PO3.	Make critical analysis, evaluationand synthesis of new ideas.
PO4.	Plan and perform independent research undertakings professionally, ethically and responsibly and to lead/supervise research projects
PO5.	Ethics: Convey and practice social, environmental and research ethics.
PO6.	Environment and Sustainability: Insist the significance of conserving a clean environment for perpetuation and sustainable development.
PO7.	Report research findings toppers at levels suitable for international publications
PO8.	Recognize the needs for continuing professional development & create different opportunities for others aiming at the growth of society.
PO9.	Facilitate students to take-up successful career in research& provide expert advice to society in the relevant field
PO10	Build entrepreneur life skills in different research areas& adapt practical skills leading to innovative ideas in the relevant field

ANNEXURE-2(i)

The Scheme of Examination for the PhD Course work

S.No.	Course Code	Course Name	Credit offered				MTE			ETE (Duration 3 hrs)	Total Marks
			L	T	P	Total	MST (30)	Ass/ Pr (10)	A (10)	(50)	
1	CC20P101	Research Methodology and Data Analysis Tools	4	-	-	4	30	10	10	50	100
2	XX20P104	Discipline Specific Course	4	-	-	4	30	10	10	50	100
3	CC20P102	Research and Publication Ethics	4	-	-	4	30	10	10	50	100
4	CC20P104	Seminar / Presentation*	16**			4	30	10	10	50	100
						16					-

MST- Mid Semester Test; Ass/Pr- Assignment/Presentation; A- Attendance; XX- first two digit of the specialization

**** Candidate needs to make continuous presentation every week as well as to the Panel of Experts on Literature Review on Topic of Research.***

** Candidate has to do self-study of 14 hrs. per week and attend presentations of 2 hrs. per week.

LIST OF COURSES

S.No.	Course Code	Course Name	Discipline	Annexure No
1	CC20P101	RESEARCH METHODOLOGYAND DATA ANALYTICAL TOOLS	CORE COURSE	2(ii)
2	CC20P102	RESEARCH AND PUBLICATION EHICS	CORE COURSE	2(iii)
3	CC20P103	SEMINAR PRESENTATION	CORE COURSE	2(iv)
4	MG20P104	PRINCIPLES AND PRACTICES OF MANAGEMENT	MANAGEMENT	3
5	CS20P104	COMPUTER SCIENCE & ENGINEERING	ENGINEERING	4
6	CE20P104	CIVIL ENGINEERING	ENGINEERING	5
7	EC20P104	ELECTRONICS & COMMUNICATION ENGINEERING	ENGINEERING	6
8	BO20P104	BOTANY	BIOLOGY	7
9	CH20P104	PHYSICAL METHODS IN CHEMISTRY	CHEMISTRY	8
10	MB20P104	MICROBIOLOGY	BIOLOGY	9
11	BT20P104	BIOTECHNOLOGY	BIOLOGY	10
12	HI20P104	HISTORY	ARTS	11

ANNEXURE-2(ii)

SYLLABUS

Core Course

Course Code: CC20P101	Research Methodology and Data Analytical Tools	Credits: 4
Course Objectives	1. To equip the students with the concept and methods of Research. 2. To plan and design research using scientific and statistical methods. 3. To analyze the data using statistical methods/Simulators	
Pre-requisites	None.	
UNIT	CONTENT	HOURS
I	**Introduction:** Concepts, Definition, Motivation in Research, Types of Research - Exploratory Research, Descriptive Research, Causal Research Analytical Research, Research process, Problem formulation, Approaches to Research, Review of Literature, Importance of reviewing the literature, Methods to write review of literature, Research gap, Research Design.	8
II	**Sampling Techniques**: Sampling and sampling distribution: Meaning, sampling Vs Census, Steps in Sampling process, Types of sampling - Probability and Non probability Sampling Techniques.	7
III	**Measurement, Scaling Techniques and Data Collection Methods:** Nominal Scale, Ordinal Scale, Interval Scale, Ratio Scale, Criteria for good measurement, Attitude measurement Scale – Likert's Scale, Semantic Differential Scale, Thurstone-equal appearing interval scale. **Data Collection:** Primary and Secondary data Sources - Advantages/Disadvantages, Data collection Methods: Observations, Survey, Interview and Questionnaire design, Qualitative Techniques of data collection.	15
IV	**Statistical Tools for Data Analysis:** Introduction to Probability Sample space and events, definitions of probability, properties of probability, Random variable Probability distribution Discrete and continuous random variable, conditional probability, Bayes' theorem and independence, Poisson, geometric, Binomial and Normal distribution. Mean, Median, Mode ,Quartiles, Deciles and Percentiles , Measures of Dispersion: Standard Deviation -Variance - Coefficient of Variance, Skewness, Correlation and regression analysis Definition, Assumption of Correlation, Bivariate Correlation, Partial Correlation, Correlation Coefficients: Pearson, Kendall, Spearman, Objectives of Regression Analysis, Assumption of Regression Analysis, Simple Regression Model, Multiple Regressions Model,	15

	Coefficient of regression and their properties. Formulation of hypothesis-Testing of hypothesis, Type I and Type II Errors. Parametric tests: Z-test, t-test, F-test, Analysis of Variance; One-Way and Two-way classification. Non parametric tests - Chi-Square test.	
V	**Software's Support for Research:** Software for Data Analysis: Data representation, MS-Excel, AMOS, SPSS, MATLAB. MS-Word: Page setup, Margin, Alignments, working with font and paragraph, Various menu options/ribbon options (File, Edit, View, Insert, Format, Tools, Tables, Windows, Help). MS-PowerPoint: Creating a new PPT, working with templates, Menu options, Custom animation. *Appropriate software or software package can be added in the subject specific syllabus for data analysis, as per requirement of the researcher/ area like Introduction to R can be added to Engineering Stream and Engineering Management/ Operations Management.	11
VI	**Report Writing:** Importance of report writing, Types of reports, writing research proposal and synopsis, planning phase of report writing, chapter formation, referencing styles, plagiarism, ethics in research, characteristics of a good research report.	4
	Course Outcomes as per Bloom's Taxonomy	
CO1	Students will **understand**[2] basics of research methodology	
CO2	Students will be able to **explain**[3] the importance of research methodology for Nation, Society, education, and self.	
CO3	Students will be able to **identify**[3] the problem statements for research and solutions to it.	
CO4	Students will be able to **Analyze**[4]the data /situations by using statistical method and specific Simulator	
CO5	Students will also be able to **evaluate**[5] and **create**[6] a new device/ system/ process/ method and create new knowledge for decision making	
Text Books	1. Cooper Donald R and Schindler Pamela S. (2006). Business Research Methods. McGraw-Hill Education. India 2. Gupta, S.L., Gupta, H. (2011). SPSS 17.0 for Researchers. International Book House (Pvt.) Limited, (2), New Delhi. 3. Gupta S. P. (2014). Statistical Methods. Sultan Chand and Sons. India 4. Kothari C. R. (2014). Research Methodology: Methods and Techniques. New Age International (P) Publisher. New Delhi 5. Lambert, Joan, Frye, Curtis D. (2016). Microsoft Office 2016 Step by Step. PHI.	
Reference Books	1. Krishnaswami O. R., Ranganatham M. (2011). Methodology of Research in Social Sciences. Himalaya Publishing House. India 2. Sekaran Uma (2003). Research Methods for Business. Wiley India. 3. Levin and Rubin (2008). Statistics for Management. Dorling Kindersley Pvt Ltd. India 4. Milligan J. (2015). Learning Tableau. PACKET Publisher, India. 5. Zikmund, Babin,Carr,Griffin (2003). Business Research Methods. Cengage Learning, India.	

ANNEXURE-2(iii)

Core Course

Course Code: CC20P102	**Research Publication and Ethics (RPE)**	Credits: 4
Course Objectives	1. Provide students with the elemental knowledge of basics of philosophy of science and ethics, research integrity, publication ethics. 2. Prepare students to spot research misconduct and predatory publications. 3. Indexing and citation databases, open access publications, research metrics (citations, h- index, Impact Factor etc).	
Pre-requisites		
UNIT	CONTENT	HOURS
I	**Philosophy and Ethics:** Introduction to philosophy: definition, nature and scope, concept, branches. Ethics: definition, moral philosophy, nature of moral judgements and reactions. Scientific Conduct: Ethics with respect to science and research; intellectual honesty and research integrity; scientific misconducts: falsification, fabrication, and plagiarism (FFP); redundant publications: duplicate and overlapping publications, salami slicing;selective reporting and misrepresentation of data.	8
II	**Publication Ethics:** Publication ethics: definition, introduction and importance; best practices / standards setting initiatives and guidelines: COPE, WAME, etc.; conflicts of interest; misconduct in publication: definition, concept, problems that lead to unethical behaviour and vice versa, types; violation of publication ethics, authorship and contributorship; identification of publication misconduct, complaints and appeals; predatory publishers and journals.	7
III	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; software tool to identify predatory publications developed by SPPU; journal finder / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal etc. **Publication Misconduct:** Group Discussions: subject specific ethical issues, FFP, authorship; conflicts of interest; complaints and appeals: examples and fraud from India and abroad; Databases and Research Metrics: Databases: indexing databases; citation databases: Web of Science, Scopus, etc.; Research Metrics: Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score; metrics: h-index, g index, i10 index, altmetrics.	8
IV	**Ethics in writing:** What is ethical writing and why is it important? Literature review and proper use of e-resources for referencing, provide reasons why plagiarism awareness is important, identify and define different types of plagiarism, explain strategies for preventing plagiarism, using design thinking methods to avoid plagiarism. Writing quality academic publications: challenges to avoid plagiarism; scientific reading, cite and write, describe copyright and how to use others' work ethically;	10

	report writing using popular word processing packages such as MS Word, Open Office etc., how to determine the credibility of a source.	
V	**Introduction to Reference Management Tools (RMT):** Features and functionalities of anti-plagiarism software, detection of plagiarism by using different online tools agencies and organization dealing with plagiarism issues(eg. retract/deluze), use of plagiarism software like Tumitin, Urkund and other open source software tools plagiarism policies, penalties and consequences.	15
	Course Outcomes as per Bloom's Taxonomy	
CO1	Students will **understand**[2] the basics of philosophy of science.	
CO2	Students will be able to **explain**[3] the importance of being ethical in carrying out research and publication activities.	
CO3	Students will be able to identify3 the quality publication and how to be cognizant about dubious publishing practices/publishers.	
CO4	Students will be able to **utilize**[3] their knowledge to write avoiding plagiarism.	
CO5	Students will also **develop**[3] knowledge about the software/databases which are required for carrying out research work.	
Text Books	1. S. K. Yadav, Research and Publication Ethics, Ane Books Publication, 2020. 2. S. Gupta and S. Kamboj, Research and Publication Ethics, Alexis Press LLC, 2020. 3. K. Muralidhar, A. Ghosh and A. K. Singhvi, Ethics in Science Education, research and Governance, Indian National Science Academy (INSA) New Delhi, ISBN: 978-81-939482-1-7, 2019	
Reference Books	1. S. Hook, P. Kurtz, M. Todorovich, The Ethics of Teaching and Scientific Research, Prometheus Books, 1977. 2. B. Stanley, J.E. Sieber, G. B. Nelton, Research Ethics: A Psychological Approach, University of Nebraska Press, 1996.	

ANNEXURE-2(iv)

Core Course

Course Code: CC20P102	**Seminar\ Presentation**	Credits: 4
Course Objectives	Prepare students with the knowledge of current scenario and trends of research area of his/her interest. To enhance command over communication skill and presentation skills..	
Pre-requisites	Student need to develop observation, understanding and presentation skills	
Guidelines For Evaluation	There will be continuous evaluation and end semester evaluation- where 50% evaluation will be in continuous and 50 % end semester **Continuous Evaluation** A] Every Saturday student has to make and deliver presentation, based on the review of five research papers. B] Student has to make minimum 10 presentation, five marks each presentation. C] Best ten presentations would be counted for the final internal assessment **End Semester Evaluation** A] Student has to prepare a review paper and it is to published or accepted in peer reviewed journal with good impact factor, which is listed in Scopus/SCI/WOS/UGC// any other journal of repute/conference proceedings. This paper should have identified research Gaps for future work. **It will be evaluate for 25 marks.** B] A comprehensive presentation of work of complete semester to the panel of experts for 20 minutes for presentation and 10 minutes for questions/Viva Voce. **It will be evaluate for 25 marks.** Note: The research paper should be designed in standard format of IEEE/APA.	**Total presentations- 12 (Each Saturday for 2 hrs common presentation)**
	Course Outcomes as per Bloom's Taxonomy	
CO1	To develop basic **understanding**[2] of research area of specific subject	
CO2	To develop the comprehensive understanding of reviewof papers and be able to **analyze**[4] the findings	
CO3	To **find**[2] out the research gap in his/her research field and **formulate**[3] objectives for his/.her work	
CO4	To **analyze**[4] the exiting methods/practices and would be able to apply in the proposed research work	
CO5	To **publish**[5] review based research paper	
Reference Books:	• Emma Ledden, The Presentation Book: How to Create it, shape it and deliver it., Pearson Business; 2nd edition, 2017 • Ed Gregorich, How to write a review paper, csa news, Vol 64, No1, 2019 https://doi.org/10.2134/csa2019.64.0115	

- Self Study

ANNEXURE-3

Discipline Specific Course

Course Code: MG20P104	**Principles and Practices of Management**	Credits: 4
Course Objectives	1. To understand the core management principles which applies to individuals, medium and large organizations. 2. The students are expected to learn the basics of management functions and realize the ideal characteristics of a manager. 3. The impetus of this subject is to make the students familiarize with the professional skills required to be an effective manager.	
Pre-requisites	None.	
UNIT	CONTENT	HOURS
I	**Nature and Evolution of Management:** Meaning, Nature and Scope of Management, Levels and Types of Managers, Function, Role and Skills for Managers, Evolution of Management Thought, Early Classical Approaches – Scientific Management, Administrative Management, Bureaucracy, Neo-Classical Approaches – Human Relations Movement, Behavioral Approaches, Modern Approaches – Quantitative Approach; Systems Approach; Contingency Approach	8
II	**Functions of Management** **Planning :**Meaning, Need and Importance, Planning Process, Types of Planning and, Objectives, MBO **Organizing:** Concept, Process of Organizing, Forms of Organizational Structure, Formal and Informal Organizations **Staffing and Directing:** Concept, Manpower Planning, Directing **Controlling and Reviewing:** Concept of Controlling, Types of Controls, Controlling Process.	7
III	**Human Resource Management:** Human Resource: Meaning and importance, Human Resource Management: Definition, Meaning and Significance, Functions of HRM and Technology Implementation to foster Functions of HRM, Shift of Human Resource towards more full time remote work, Technology Adoption for Training and Development, Investment in Employees' Mental Health, Technology Based Leadership, Servant Leadership	8
IV	**Marketing Management:** Marketing Concepts: Nature and scope of marketing, Evolution, Various marketing orientations, Market Segmentation, Targeting, Positioning and Branding, Products and Pricing, Distribution Decisions, Integrated Marketing Communications, Digital Marketing, SEO, Direct and Online Marketing, Chatbots and AI go mainstream, Embrace the IoT	10
V	**Financial Management:** Introduction to Financial Management, Sources of Finance, Cost of Capital and Capital Structure Decision, Investment Decisions, Working Capital Management, Cloud based Accounting, Technology-driven tax and reporting compliance, Self-service finance-governed analytics and use of AI	15
	Course Outcome as per Bloom's Taxonomy	
CO1	The students will **understand**[2] the major functions of management viz. Planning, Organizing, Staffing, leading and controlling.	
CO2	They will be able to **explain**[3] and describe the interrelationship among the various functions of Management.	

CO3	They will be able to **identify**[3] new vistas in management and their utilization for effective management.	
CO4	They will be able to **utilize**[3] knowledge of management in social and professional life.	
CO5	They will also **develop**[3] holistic understanding of management.	
Text Books	1. Koontz and Weihrich, H. (2008). **Essentials of Management.** Tata McGraw-Hill Education, India. 2. Robbins and Coulter (2007). **Management**. Prentice Hall of India. 3. Khan, M., Y. and Jain P., K. (2007). **Financial Management**. Tata McGraw Hill. **4.** Rosalind, M. and Pickton, D. (2014). **Marketing: An Introduction.** Sage Publications, India. **5.** Michael, A. (2008). **Handbook of Human Resource Management Practice.** Kogan Page, London	
Reference Books	1. Koontz and Weihrich, H. (2008). **Essentials of Management**. Tata McGraw-Hill Education, India. 2. Dessler, G. (2016). **Human Resource Management.** Pearsons Education Delhi, India. 3. Kotler, Keller, Koshy and Jha (2009). Marketing Management: A South Asian Perspective. Pearson Education, India. 4. Pandey, I., M. (2009). Financial Management. Vikas Publications, New Delhi, India.	

ANNEXURE-4

Discipline Specific Course

Course Code: CS20P104	**Computer Science & Engineering**	Credits: 4

Course Objectives	1. Students would learn the basic trends of research on the area of Computer Science and Engineering 2. Students would develop the understanding of optimization techniques, algorithms and develop understanding of AI and ML 3. Student would learn the different paper writing tools and software.	
Pre-requisites		
UNIT	CONTENTS	HOURS
I	Introduction to Cyber Crime & Threat: Types of Cyber Crimes, Threat, Cyber security, recent threats to cyber domain, Internet, Privacy. Cyber Laws and Ethics. Cyber Security Threats Unauthorized Access, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Software Piracy.	8
II	Optimization Techniques:Engineering application of Optimization, Formulation of design problems as mathematical programming problems,General Structure of Optimization Algorithms, Constraints, The Feasible Region, Optimization Algorithms like Genetic Optimization, Particle Swarm Optimization, Ant Colony Optimization etc. Real life Problems and their mathematical formulation as standard programming problems.	7
III	Introduction to AI: history of AI ,What is AI, Turing test, cognitive modelling approach, law of thoughts, the relational agent approach, the underlying assumptions about intelligence, techniques required to solve AI problems, level of details required to model human intelligence, successfully building an intelligent problem, Applications of AI by domain: Transportation, home/service robots, healthcare, education, low- resource communities, public safety and security, employment and workplace, entertainment, finance, banking and insurance.	8
IV	Recent Research Trends: Research trends in machine learning, deep learning, reinforcement learning, robotics, computer vision, natural language processing, ANN, collaborative systems, algorithmic game theory, internet of things (IoT), neuromorphic computing.	10
V	Paper Writing tools and Software: Microsoft word, Latex, Open Office, Libre Office, Google Docs, Referencing Tools and Reference Management Software: Mendeley, Zotero, Endnote, Refworks,Research Tools and Software:REF-N-WRITE, Online Statistical testing tools, Microsoft Excel, Google Scholar, Research Gate, Plagiarism Checker, Project Management Tools,Grammar Checkers and Sentence Correction Tools:MS Word Spelling & Grammar checker, Grammarly, ProWriting aid, StyleWriter, White Smoke, Ginger Software, Online Grammar checking sites	15
	Course Outcome as per Bloom's Taxonomy	
CO1	Students will **understand**[2] and **apply**[3] the concept of optimality criteria for various type of optimization problems.	
CO2	Students will**Apply**[3]the methods of optimization in real life situation.	
CO3	Students will be able to **analyze**[4] and **evaluate**[5] the existing algorithms for any application	
CO4	Students would be able to **Implement**[5] the uses of AI in various applications.	
CO5	Students will be able to **understand**[2] the security issues	
Text Books	1. Andreas Antoniou, Practical Optimization Algorithms and Engineering Applications. 2. Edwin K., P. Chong & Stanislaw h. Zak ,An Introduction to Optimization.	

	3. Peter Norvig and Stuart J. Russell (2003), "Artificial Intelligence: A Modern Approach", 4/E , Prentice Hall . 4. James S Tiller (2019),The ethical hack:A framework for business value penetration testing, CRC Press	
Reference Books	1. Patterson, Introduction To Artificial Intelligence & Expert Systems, , PHI 2. Russell and Norvig, Artificial Intelligence : A modern Approach, , PHI 3. Douglas W. Hubbard & Richard Seiersen (2016), How to Measure Anything in Cyber security Risk. (ISBN: 9781119085294)	

ANNEXURE-5

Discipline Specific Course

Course Code: CE20P104	**Advanced Civil Engineering**	Credits: 4
Course Objectives	1.Students would learn the basic trends of research on the area of Advanced Civil Engineering. 2. Students would develop the understanding of Advanced Materials used in civil engineering, impact of construction on environment different smart	

	materials and use of IoT 3. Student would learn the various software's used in Civil Engineering.	
Pre-requisites		
UNIT	CONTENTS	HOURS
I	**Advanced Civil Engineering Materials** Plastics, Glass, plywood, Fly ash, Rubber, Heat insulating materials, Sound absorbent materials, Steel, Composite Materials Unidirectional composites, Short fiber composites, rubber reinforced composites, laminated composites, Fiber reinforced plastics (FRP), Steel fibrous concrete	8
II	Sustainability in construction Sustainability, Construction impact on the environment, Sustainability assessment, Ensure Sustainable Construction, Biodiversity Enhancement, Support to the Community, Effective Use of Resources, Pollution Reduction, Creating Healthy Environment, Process Management.	7
III	Structures and Smart Materials : Introduction to Smart Materials and Structures, Measuring Techniques ,Strain Measuring Techniques Using Electrical Strain Gauges, . Sensors, Sensing Technology, Types of sensors, Actuators, Actuator Techniques, Actuator And Actuator Materials, Signal Processing And Control Systems, Data Acquisition And Processing	8
IV	Internet of Things (IOT): Introduction: Definition, Characteristics of IOT, IOT Conceptual framework, IOT Architectural view, Physical design of IOT, Logical design of IOT, Application of IOT.	10
V	Civil Engineering Software's, AUTOCAD for Drafting, STAAD PRO for Design and Analysis, PRIMAVERA for Construction Management, REVIT Structure for Building Information Modelling, ETABS for Design and Analysis, SAP 2000 , MS EXCEL , ARCGIS for Surveying , 3DS Max – Modelling , MX Road - Road design and Analysis	15
	Course Outcome as per Bloom's Taxonomy	
CO1	Students will**Learn**[1]about **use**[3] of advanced Civil Engineering Materials	
CO2	Students will**Apply**[3] Sustainability in construction	
CO3	Students would be able to **Use**[3] of Smart Structures and Smart Materials	
CO4	Students will**Understand**[2] in depth about Internet of things.	
CO5	Students will**Understand**[2] about software's used in civil engineering	
Text Books	1. Rangwala S C (1985), "Engineering Materials" CharotarPublishing House, Anand. 2. Raina K B (1999), "Civil Engineering Materials" Tata McGraw-Hill Publishing Company Ltd., New Delhi. 3. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle (2014), "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press	
Reference Books	1. Brain Culshaw (1996), "Smart Structure and Materials", Artech House – Borton. London. 2. L. S. Srinath (1998), "Experimental Stress Analysis", Tata McGraw-Hill.	

ANNEXURE-6

Discipline Specific Course

Course Code: EC20P104	**Electronics & Communication Engineering**	Credits: 4
Course Objectives	1. Students would learn the basic trends of research on the area of Electronics and Communication Engineering 2. Students would develop the understanding of Wireless Communication and Networks, Image and Speech processing, VLSI circuits and Bio Medical Signal Processing. 3. Student would learn the testing of VLSI circuits.	
Pre-requisites		
UNIT	CONTENTS	HOURS
I	Wireless Communication and Networks: Wireless Communication and Networks Computer simulation of radio channels, Overview of 4G-LTE	8

	networks, IP switching and MPLS- Overview of IP over ATM and its evolution to IP switching, State of art of OFDM and MIMO, Optical communication networks- DWDM based network, Optical network on chip, Introduction to near field communication, LoRa communication.	
II	Image and Speech Processing: Image and Speech Processing Image transforms, Image compression, Image segmentation, Color image processing, Motion picture analysis, Operations in speech such as enhancement, speech recognition, reorganization, Speech encoding, Frequency domain coders, Text to speech synthesis, Speaker identification	7
III	Low Power VLSI Circuits: Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches. Device & Technology Impact on Low Power: Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation. Simulation Power analysis: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation.	8
IV	Bio Medical Signal Processing Examples of Biomedical signals - ECG, EEG, EMG etc., Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials. Illustration with case studies – Adaptive and optimal filtering - Modeling of Biomedical signals - Detection of biomedical signals in noise -removal of artifacts of one signal embedded in another -Maternal-Fetal ECG - Muscle contraction interference. Event detection - case studies with ECG & EEG - Independent component Analysis - Classification of biomedical signals.	10
V	Testing of VLSI Circuits Basics of Testing and Fault Modeling Introduction to Testing - Faults in digital circuits - Modeling of faults - Logical Fault Models - Fault detection - Fault location - Fault dominance - Logic Simulation - Types of simulation - Delay models - Gate level Event-driven simulation. Test Generation for Combinational and Sequential Circuits Test generation for combinational logic circuits - Testable combinational logic circuit design - Test generation for sequential circuits - design of testable sequential circuits.	15
	Course Outcome as per Bloom's Taxonomy	
CO1	Students will **understand**[2] the wireless communication networks.	
CO2	Students will **Apply**[3] the different techniques inimage and speech processing.	
CO3	Students will be able to **analyze**[4] and **evaluate**[5] the methods used in VLSI circuit design.	
CO4	Students would be able to **analyze**[4] different signal processing in Bio Medical field.	
CO5	Students will be able to **understand**[2] the testing of VLSI circuits.	
Text Books	1. Theodore S. Rappaport (2002), Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall. 2. .R.C. Gonzalez and P. Wintz (1987), Digital Image Processing, 2nd Ed, Addison Wesley. 3. Gary K. Yeap (2002), "Practical Low Power Digital VLSI Design", KAP. 4. D.C.Reddy(2005),"Biomedical Signal Processing: Principles and	

	techniques",Tata McGraw Hill, New Delhi. 5. M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.	
Reference Books	1. Garg V, Joseph E. Wilkes, Wireless & Personal Communication Systems, Feher/Prentice Hall. 2. Rosenfeld and A. C. Kak (1982), Digital Image Processing Academic Press, Vol-1,. 3. R. Rangayan (2002), "Biomedical Signal Analysis", Wiley. 4. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academi.	

ANNEXURE-7

Discipline Specific Course

Course Code: BO20P104	**Botany**	Credit: 04
Course Objectives	1. The Program Ph.D will develop ability to identify and solve the real world problems related to various areas of Plant Sciences. 2. It will also develop an aptitude to apply principle of plant Sciences. 3. It will provide in-depth knowledge of various fields of plants.	
Prerequisite of course	Postgraduate degree in a relevant discipline, competed from a recognized institute /university A minimum aggregate score of 55 %.	
UNIT	CONTENTS	HOURS
I	Angiosperms, Gymnosperms, Ethnobotany and biodiversity; -Recent trends in Taxonomy, Botanical Nomenclature, Herbaria and Botanical gardens. Chemotaxonomy, Recent information on fossil history of angiosperms, Biosystematics and species concept,Ethnobotany: Historical background and importance of the study,Conservation and preservation of the endangered species., Factors in the distribution of vegetation and	7

	floras. Gymnosperms: -Trend in phylogeny and classification of Gymnosperms.	
II	Algae, Bryophytes, Pteridophytes, Mycology and plant Pathology.;-History with special reference to Indian work. Application of Algae, Bryophytes, Pteridophytes, Advances in plant pathology and economic important. New trends in the classification of Algae. Economic important. In Bryophytes, Pteridophytes,	6
III	Molecular biology: -Cell organelles and their functions, DNA and RNA molecular structure. Recombinant DNA technology, Agrobacterium mediated gene transfer, genome, genetic recombination,Gene Library, Plant tissue culture, vectors, restriction enzymes.	7
IV	Advancement of Environment science Soil waste management, rain water harvesting,Environment biotechnology sewage treatment,Field work, visit to a local area to document environmental assets river/forest/grassland/hill/mountain • Visit to a local polluted site-Urban/Rural/Industrial/Agricultural •	7
V	Instrumentation and Techniques. Microscope, Microtome, Laminar air flow, centrifuge, auto clave, Hot air oven, chromatography, electronic balance, BOD, COD, pH meter histological techniques, cytological techniques, PCR Southern and Northern techniques. Plant tissue culture techniques etc.	8

Course Outcome as per Bloom's Taxonomy	
CO 1	A student completing the course is able to understand different banches of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.
CO 2	They become competent enough in various analytical and technical skills related to plant sciences.
CO 3	The course will increase the understanding of the students about the classification, structure, role and infectious cycle of microbes and Fungi.
CO 4	Understand the various principals and methods related to botany.
CO 5	The student completing the course is capable to perform research using various toolsand techniques in plant sciences and develop scientific temperament and research attitude.
Text Books	1. Schmidt-Nielsen K. Animal physiology, Adaptation and environment Cambridge university Press. 2. Bhatiya and Kohli, fundamental of Ecology. 3. VeerbalaRastogi, fundamental of Genetics 4. Sharma Jaya, Botany,KelashPushtakSadan. 5. Sharma Jaya, Plant Physiology, KelashPushtakSadan. 6. Sharma Jaya, Applied and Environment Microbiology, KelashPushtakSadan
Reference Books	1. B Schierwater, R Desalle, G P Wagne, Molecular Ecology and Evolution. 2. J.Darnell, H.Lodish, & D. Baltimore, Molecular cell biology, , Scientific American books,inc., USA 3. Daniel L Hartl, Elizabeth & Jones W, Jones, Genetics: Principles and analysis, Bartlett publishers 4. De Robertis and E.M.F. De Robertis Jr., Cell and Molecular Biology, E.D.P . Lea &Febiger 5. R.W. Old & S.B. Primrose,Principles of gene manipulations, Blackwell Science, U.K

	6. J. Palmer, Enzymes ,Harward publications. 7. B. Alberts,D. Bray, J. Lewis, M.Raff, K. Roberts & J.D Watson, Molecular biology of cells, Garlano publishing, Inc., New york.

ANNEXURE-8

Discipline Specific Course

Course Code: CH20P104	**Physical Methods in Chemistry**	Credits: 04
Course Objectives	1. Prepare students with the knowledge of molecularspectroscopy. 2. To produce students whose concepts are clear in physical methods inchemistry.	
Pre-requisite	Basic knowledge of spectroscopy.	
UNIT	**CONTENT**	**HOURS**
I	Introduction: Interaction of electromagnetic radiation with matter, transition probabilityand selection rules, line-widths and line shapes, Fourier Transforms in spectroscopy.Rotational and rotation-vibrational spectroscopy: Microwave and infrared spectroscopy of di- andpolyatomic molecules, normal coordinates and their symmetry (CO_2), skeletal vibration and group frequency, FT-IRinstrumentation. Raman spectroscopy: Raman Effect, rotational and rotation- vibrational Raman transitions, nuclear spin effects, polarization of Raman lines. Lasers and laser spectroscopy: Principles of laser action, laser characteristics, pulsed lasers, laser cavity modes, Q-switching, mode locking, non-linear effects, harmonicgeneration, examples of lasers: He-Ne, Nd-YAG, titanium-sapphire., dye lasers. Lasers in spectroscopy: Raman, hyper-Raman, CARS, femtosecond spectroscopy.	15

II	Electronic spectroscopy: Vibronic spectroscopy of diatomic molecules, Franck-Condon factor, dissociation and pre-dissociation, rotational fine structure, solvent effects, photoelectron spectroscopy (PES): UV and X-ray PES of molecules. Single molecule spectroscopy: Single molecule detection, confcocal detection optics and configuration, applications	10
III	Magneticresonance:Areviewofspinangularmomentum,basicprinciples andrelaxationtimes,intensityofNMRsignals,electronicshielding,NMR in liquids: chemical shifts, spinspin couplings, NMR spectra of AX, A3X and AB systems. ESR of hydrogen, first order hyperfine energies, ESR of organic radicals insolution. FT-NMR:Rotatingframeofreference,effectofRFpulses,FID,multipulse operation,measurementofT1byinversionrecoverymethod,spinechoand measurement of T2, 2-D NMR, NMR hardware.	10
IV	Electron Paramagnetic Resonance Spectroscopy: Theory, analysis of EPR spectra of systems in liquid phase, radicals containing single and multiple set of protons, triplet ground states, transition metal ions, rare earth ions, ions in solid state, EPR spectra of various inorganic compounds. Mossbauer Spectroscopy: Physical concepts, spectral line shape, isomer shift,quadrupolesplitting,magnetichyperfineinteraction,interpretationof Mossbauer parameters of ^{57}Fe and ^{119}Sn. Applications to Solid-state reactions, thermal decomposition, ligand exchange, electron transfer and isomerism. Mass Spectroscopy: Introduction and Applications to Isotopic systems.	15
V	Electrochemical Methods: Heterogeneous electron transfer and concept of capacitative and Faradic current. CV, DPV and coulometry. applications of CV in organic and inorganic chemistry.	10

Course Outcomes as per Bloom's Taxonomy	
CO1	The students will be able to **understand**[2]the concepts of spectroscopy.
CO2	They will be able to **illustrate**[2]Raman and laser spectroscopy.
CO3	Students will **understand**[2]the concepts of electronic spectroscopy.
CO4	They will learn to **apply**[3]the concepts of magnetic resonance spectroscopy.
CO5	They will **develop**[3]theknowledge of electrochemical method.
Text Books:	1. C. N. Banwell and E.M. Mc Cash,Fundamentals of Molecular Spectroscopy,1994, 4th edition, Tata McGraw Hill, NewDelhi. 2. R. S. Drago, Physical Methods in Inorganic Chemistry, East-West Press Pvt. Ltd.,2012. 3. J. M. Hollas,Modern Spectroscopy, 2004, 4th edition, John Wiley & Sons, Ltd., Chichester. 4. G. M. Barrow,Introduction to Molecular Spectroscopy, McGraw-Hill,1962. 5. R. V. Parrish, NMR, NQR, EPR and Mossbauer spectroscopy in Inorganic Chemistry, Ellis Horwood Limited,1990. 6. A. J. Baird and L. R. Faulkner, Electrochemical methods – Fundamentals and applications, Wiley,1980.
Reference Books:	1. ACarringtonandA.D.McLachlan,IntroductiontoMagneticResonance,Chapman and Hall, London, 1979. 2. RKHarris,NuclearMagneticResonanceSpectroscopy,AddisonWesley,Longman Ltd, London, 1986.

ANNEXURE-9

Discipline Specific Course

COURSE CODE MB20P104	**Microbiology**	Credits: 04
Course Objectives	1. Prepare students with the knowledge of microbial world. 2. To produce students whose concepts are clear in microbiology and related techniques.	
Pre-requisite	Basic knowledge of Biology.	
UNIT	**CONTENT**	HOURS
I	Animal cell culture and tissue engineering. Cell lines, cell culture growth kinetics, Basic Techniques of mammalian cell culture (Open and closed cell-cultures, Primary Cell culture), Cell surgery and Cell Fusion Methods (Preparation of anucleated cells and polykaryon cells, preparation of ghost RBCs, Preparation of mini cells, micro cells, Surgical manipulation of in vitro fertilization, Hybridoma cell preparations, Use of Hybridoma technology: e.g. M AB and other related techniques, Mini cells, micro cells and anucleated cells in fusion and their application.) Tissue Engineering: Capillary culture Units, feeder layers. Use of Animal Cells in Culture: Mutant cell preparation, Evaluation of Chemical carcinogenicity, Cell malignancy Testing, Toxicity Testing, Karyotyping and cytogenetic characterization, Production of metabolic products, ESC applications, Pluripotent stem cell applications.	15
II	Tissue culture Techniques: Animal Culture: Media requirements and sterilization techniques, primary and established cell lines. Culture methods: hanging drop, monolayer and suspension. Advantages and disadvantages. Scale up methods. Roux tubes roller bottles. Stem cells: adult and embryonic, applications to tissue engineering. Applications of animal cells. b) Plant tissue culture: Cell and callus culture, anther culture. Micropropagation, somatic cell hybridization, protoplast fusion, cybrids, artificial seeds, Agrobacterium mediated gene transfer and use of Ti plasmid. Applications of plant tissue culture engineering, pathogen resistance (BT gene), herbicide tolerance, salt tolerance, production of secondary metabolites and transgenic plants.	10
III	Molecular modeling: Introduction, force field, quantum chemistry, Schrödinger equation, potential energy functions, energy minimization, local and global minima, saddle point, grid search, , various approximations; LCAO, HF, semi-empirical calculations; single point calculations, full-geometry optimization methods, ZDO, MNDO, CNDO, NDDO, AM1, PM3, RM1, conformational search, Z-matrix, docking, molecular modeling packages. Protein structure prediction Protein Structure Prediction; Homology modeling, prediction of protein structure from sequences, functional sites, Protein folding problem, protein folding classes, protein identification and characterization; structure determination by X-ray and NMR.	10

IV	Microbial and Cellular Techniques: Microscopic techniques; Microbial growth and kinetics (synchronous culture, continuous and batch and fed-batch cultures, chemostat and turbidostat); Methods for identifying microbes (polyphasic approach); Cell disruption and fractionation of organelles; Isolation and purification of membrane proteins; Various methods to study cell-cell and cell-virus fusion; Flow cytometry techniques; Confocal and Atomic Force Microscopy; Types of Biosafety cabinets.	15
V	Molecular genetics/Microbiology: Studies of the mechanism for plasmid replication, construction of cloning vectors and analysis of recombinant protein expression. Genetic analysis of the production of antibiotics in bacteria. Studies of molecular mechanisms for cellular osmoregulation. The genetics of alginate biosynthesis and function studies of the enzyme structures, Oil microbiology, Development of new plasmid tools for use in bioprospecting, Microbial producers of bioactive agents from the marine environment.	10
	Course Outcomes as per Bloom's Taxonomy	
CO1	The students will be able to **understand**[2]the concepts of microbiology.	
CO2	They will be able to **illustrate**[2]methods in microbiology.	
CO3	Students will **understand**[2]the microbiology and biotechnology.	
CO4	They will learn to **apply**[3]the concepts of microbiology.	
CO5	They will **develop**[3]the knowledge of microbiology and various aspects of it.	
Text Books:	1. Razdan, M. K. Introduction to Plant Tissue Culture. 2nd Edition. Oxford & IBH. 2008. 2. Ausubel FW. Current Protocols in Molecular Biology. Wiley-Blackwell. 2011. 3. Burgess R. and Deutcher MP. Guide to Protein Purification. Academic Press, SanDiego, USA. 2009. 4. Butler, M. Animal Cell Culture & Technology. 1st edition. Tailor & Francis Publishers (UK) 2004.	

ANNEXURE-10

Discipline Specific Course

COURSE CODE	**BIOTECHNOLOGY**	**Total Lec.: 60**
BT20P104		**3-1-0**
Course Objectives:	1. Prepare students with the knowledge of different trends in biotechnology. 2. To prepare students as a research scholar well equipped and practiced in biotechniques. 3. To develop a research aptitude and critical thinking in the research scholar.	
Pre-requisite	Basic knowledge of Molecular Biology and Basic Cellular Techniques.	
UNIT	**CONTENT**	**HOURS**
I	Microbial, Cellular Techniques and Proteomics Microscopic techniques; Microbial growth and kinetics (synchronous culture, continuous and batch and fed-batch cultures, chemostat and turbidostat); Methods for identifying microbes (polyphasic approach); Cell disruption and fractionation of organelles; Isolation and purification of membrane proteins; Various methods to study cell-cell and cell-virus fusion; Flow cytometry techniques; Confocal and Atomic Force Microscopy; Types of Biosafety cabinets. UV and fluorescence spectroscopy; Circular Dichroism; Mass spectrometry - Principles and their applications; Protein separation techniques and instrumentation (Gel filtration, Ion exchange and Affinity chromatography, 1D and 2D Polyacrylamide gel electrophoresis).	15
II	Recombinant DNA techniques and Genomics Use of Restriction and modification enzymes in cloning; Plasmid vector; Transformation and Plasmid isolation; PCR; DNA sequencing methods (Sanger's chain termination method, and automated DNA sequencing); Next generation sequencing (NGS); Global expression profiling; Whole genome analysis of mRNA and protein expression; Real time PCR and Microarrays and their applications.	10
III	Gene expression, Genetic Manipulation and transcriptomics: Use of reporter genes-enzymatic and bioluminescent reporters. S1 nuclease mapping, primer extension / 5' RACE. Transcriptome analysis by differential Display-PCR, Q-PCR, EST analysis, DNA microarrays, Serial Analysis of Gene Expression (SAGE), RNA-Seq, in-situ hybridization. Use of inducible bacterial promoters for expression of various proteins including toxic and membrane proteins. Expression systems in S. cerevisiae, plant systems. CRISPR/Cas9 and Targeted Genome Editing, Transient Gene silencing and knockout approaches (siRNA, shRNA, microRNA). New biomedical and pharmaceutical applications of alginates, chitosans, gelatin and proteoglycans, Capsule- and gel technology applied in food.	10

IV	Analysis of protein and Protein engineering DNA and protein-protein interactions: Electrophoretic mobility shift assays, DNA footprinting by DNase I and dimethyl sulphate, ChIP- chips. Yeast two hybrid systems. Co-immunoprecipitations and pull-downs. Use of fluorescent tags for protein localization study, Phage display. Surface Plasmon Resonance (SPR), Isothermal, Calorimetry. Concept of protein structure, conserved residues, catalytic site. Site directed mutagenesis by conventional and PCR-based methods. Cysteine and Linker scanning mutagenesis. Genome shuffling.	15
V	Environmental biotechnology and basics of bio techniques in laboratory Biofilm formation and biofouling, Gel-immobilized microbial ecosystems, Anaerobic fermentation of organic material, Directing microbial environment in marine aquaculture, Mechanisms for bacterial colonization and directing microbial environment in marine aquaculture, Structure and stability in natural pelagic ecosystems. Preparation of solutions; Concepts of solution strength (concentration); Sterilization of solutions; Preparation of Buffers - Concept of pKa and Henderson-Hasselbach equation; Concept of conjugate acid and base.	10
Course Outcomes as per Bloom's Taxonomy		
CO1	The students will be able to **understand**[2]basic concept of Recombinant DNA techniques and Genomics.	
CO2	They will be able to **illustrate**[2]Analysis of protein.	
CO3	Students will **understand**[2]the concepts of Gene expression.	
CO4	They will learn to **apply**[3]the concepts of bio techniques in laboratory.	
CO5	They will **develop**[3]the knowledge of Protein engineering.	
Text Books:	• Razdan, M. K. Introduction to Plant Tissue Culture. 2nd Edition. Oxford & IBH. 2008. • Ausubel FW. Current Protocols in Molecular Biology. Wiley-Blackwell. 2011. • Burgess R. and Deutcher MP. Guide to Protein Purification. Academic Press, SanDiego, USA. 2009. • Butler, M. Animal Cell Culture & Technology. 1st edition. Tailor & Francis Publishers(UK)2004. • Freshney, R.I. Culture of Animal cells: A Manual of Basic Technique and specialized applications. 7th edition. Wiley-Blackwell. 2016. • Green M.R. and Sambrook J. Molecular Cloning: A Laboratory Manual. Vol. I, II, III. 4th edition. Cold spring harbor laboratory press. 2013.	
Reference Books:	• Plummer D.T. An Introduction to Practical Biochemistry. 3rd edition. McGraw Hill Higher Education. 2001. • Sheehan, David. Physical Biochemistry: Principles and Applications. 2nd edition. Wiley.2009. • Wilson K. and Walker J. Principles and Techniques of Biochemistry and Molecular Biology. 7th edition. Cambridge University Press India Pvt. Ltd. 2010.	