Jaypee Institute of Information Technology

B.Tech. Biotechnology

Semester V

Course Descriptions

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B11BT511	**Semester** Odd **(specify Odd/Even)**	**Semester V Session** 2019 -2020 **Month from** July to December
Course Name	Cell Culture Technology		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr Rachana
	Teacher(s) (Alphabetically)	Dr Indira P Sarethy Dr Rachana

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO310.1	Demonstrate knowledge on principles of plant and animal tissue culture.	C2
CO310.2	Identify the requirements to construct a cell culture laboratory.	C3
CO310.3	Apply knowledge and techniques to maintain different types of cell cultures.	C3
CO310.4	Examine cell culture techniques for applications in different fields of biotechnology.	C4

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Plant Cell Culture: An Introduction	Definitions, history of plant cell and tissue culture	2
2.	Organization of tissue culture laboratory & basic principles	Equipments, media preparation and precautions, **c**ellular totipotency and cell differentiation, factors affecting differentiation	4
3.	Suspension cultures	Isolation of single plant cells, suspension cultures and types, measurement of growth, assessment of viability of cultured cells, bioreactors.	3
4.	Type of cultures and their applications	Direct and indirect methods of culture; seed culture, embryo culture, organ culture, callus culture, haploid and triploid production, protoplast isolation and fusion, production of virus free plants, somaclonal variation	6
5.	Somatic embryogenesis & micropropagation	Technique, applications and advances in acclimatization of tissue cultured plants.	4
6.	Industrial applications	Secondary metabolite production and bioconversions through plant cell cultures	2
7.	Introduction to animal cell culture	Advantages and limitations, Laboratory design and layout, aseptic techniques; safety and biohazards, contaminations and eradication	4

8.	Environmental factors and cell culture methods	Culture media, use of serum and serum free media, primary culture, subculture and cell lines, feeder layers; animal cell lines (suspension versus adhered cell culture), Cryopreservation	7
9.	Biology of cultured cells	Cell adhesion molécules, extra-cellular matrix, cell prolifération	2
10.	Characterization of cultured cells	Authentication, Cell morphology, karyotyping, staining, isoenzyme analysis; DNA fingerprinting and DNA profiling	3
11.	Cell separation technology	Physical properties (Density gradient centrifugation), Biological properties (Panning), FACS	3
12.	Scaling up-techniques	suspension and monolayer cultures	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (…)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	S. S. Bhojwani and M. K. Razadan, Plant tissue culture: theory and Practice, Elsevier, 1996
2.	H. S. Chawla, Introduction to Plant Biotechnology, 3rd Edition, Science Publishers, 2009
3.	S. Narayanaswamy, Plant cell and tissue culture, Tata Mcgraw Hill, 1992
4.	M. K. Razdan, Introduction To Plant Tissue Culture, India Book House Limited, 2003
5.	R. Ian Freshney, Culture of animal cells : a manual of basic techniques, Wiley-Liss, 2005
6.	John R. W. Masters, Animal cell culture, 3rd Edition, Oxford University Press, 2000
7.	A. Mukhopadhyay, Animal Cell Technology, I.K. International, 2009

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B11BT512	**Semester** ODD **(specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** July to December
Course Name	FERMENTATION & DOWNSTREAM PROCESSING		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	DR. SUDHA SRIVASTAVA
	Teacher(s) (Alphabetically)	Dr. Sudha Srivastava, Dr. Vibha Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C311.1	**Explain unit operations in downstream processing**	**C2**
C311.2	**Summarize media optimization, microrganism isolation, preservation and enrichment**	**C2**
C311.3	**Apply unit operation calculation to solve industrial scale problems**	**C3**
C311.4	**Determine an optimum fermentation and purification strategies**	**C5**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to fermentation processes**	Isolation, preservation and improvement of industrially important microorganisms	6
2.	**Media**	Media for industrial fermentations, upstream processes	5
3.	**Bioprocess Considerations**	Bioprocess Considerations for Animal cell cultures & plant cell cultures	5
4.	**Downstream Processing -I**	Strategy to recover and purify products, Filtration, centrifugation	6
5.	**Downstream Processing -II**	Separation of insoluble products - Cell disruption : Physical methods, Chemical methods	2
6.	**Downstream Processing -III**	Separation of soluble products- liquid-liquid extraction: solvent recovery, two phase aqueous extraction, Chromatography	12
7.	**Process design of Industrial Bio-products**	Anaerobic bioprocesses- Ethanol and lactic acid production, Aerobic bioprocesses- Citric acid and penicillin production	6
		Total number of Lectures	**42**
Evaluation Criteria			

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Class Test, Assignment, Quiz)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Principles of Fermentation Technology P. F. Stanbury, A. Whitaker, S. J. Hall Butterworth-Heinemann,2005
2.	Bioprocess engineering M.L Schuler and F. Kargi; prentice Hall,2005

Detailed Syllabus
Lab-wise Breakup

Course Code	**15B17BT571**	**Semester - Odd (specify Odd/Even)**	**Semester** V **Session** 2019 - 2020 **Month from** July to December
Course Name	**Cell Culture Lab**		
Credits	4	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Dr. Rachana
	Teacher(s) (Alphabetically)	Dr. Priyadarshini Dr. Rachana (Coordinator) Dr. Reema Gabrani

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO370.1	Understand requirements for *in vitro* culturing of animal cells	C2
CO370.2	Apply the fundamental knowledge of cell culture techniques to maintain animal cell lines	C3
CO370.3	Identify, separate, characterize and differentiate cells for primary and continuous cell lines	C2
CO370.4	Demonstrate practical skills to apply laboratory procedures of cell culture for biotechnology investigations	C3

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Basic preparations and conduction for Animal Tissue Culture Lab	General Introduction and familiarization to animal tissue culture lab: Design and Equipments, learn media preparation (complete and incomplete), sterilization and associated precaution	1 and 2
2.	Identification and maintenance of cell cultures	Learn primary cell culture (cheek cells) isolation, staining and their identification, Detection of various cell culture contaminations (bacterial, fungal) through microscopic examination and Staining, qualitative analysis and differentiation between suspension and adherent cell lines using inverted microscope.	2
3.	Propagation and sub culturing of Cell Culture	Sub culturing of (Splitting and Trypsinization) suspension and adherent cell-lines, Cryo-preservation and resuscitation of Frozen Cell Lines. Differentiation of WTC parental cell line to cardiac cell line	2 and 3
4.	Counting, Estimation and Cell based assays	To learn serial dilution techniques and to calculate cell concentration in order to set up various types of assay's, using haemocytometer and calculation of cell viability in the isolated cells using Trypan blue assay, preparation of growth curve and calculation of doubling time for cell line, determination of cytotoxicity and oxidative stress of the given compound using MTT/NRU, LDH/NO etc. assay.	3 and 4

		Total number of labs = 12	

Evaluation Criteria

Components	**Maximum Marks**
Mid-Semester lab-viva/ test	20
End-Semester lab-viva/ test	20
Day to Day performance (Learning laboratory Skills and handling Laboratory Equipments, attendance)	45
Laboratory record	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Readings in Mammalian cell culture. R. Pollack., Cold Spring Harbour Laboratory (1981).
2.	Animal Cell Culture. R. Pollack and S. Pfeiffer, Cold Spring Harbour Laboratory (1971).
3.	Experiments with Normal and Transformed cells. R.Crowe., H. Ozer and Dr. Rifkin. Cold Spring Harbour Laboratory (1978).
4	Culture of Animal Cells. R. Ian Freshney and R. Alan., Liss. Inc. (1987).
5.	Animal cell biotechnology. Vol. I and II, R.E. Spier and J. B. Griffiths, Academic Press (1985).

Detailed Syllabus
Lab-wise Breakup

Course Code	15B17BT572	**Semester** ODD **(specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** JULY to DECEMBER
Course Name	FERMENTATION & DOWNSTREAM PROCESSING LAB		
Credits	1	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Vibha Gupta
	Teacher(s) (Alphabetically)	Shalini mani Sudha Srivastava Vibha Gupta

COURSE OUTCOMES		**COGNITIVE LEVELS**
C371.1	Demonstrate separation of insoluble components	Understanding [C2]
C371.2	Apply cell lysis, protein concentration and purification techniques for isolation of desired protein	Understanding [C2]
C371.3	Design a downstream processing strategy for purification of desired molecule from culture broth	Analyzing [C4]
C371.4	Analyze the experimental result and document in a scientific manner	Analyzing [C4]

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	**Growth of micro organism & Removal of insoluble**	Growth of *Bacillus subtilis* culture for amylase production	**CO1** [C2]
2.	Protein precipitation	Precipitation of the protein from supernatant of culture broth using ammonium sulphate	**CO2** [C2]
3.		Precipitation of the protein from supernatant of culture broth using TCA	**CO2** [C2]
4.		Precipitation of the protein from supernatant of culture broth using Ethanol	**CO2** [C2]
5.	Electrodialysis	Removal of salt from protein extracts using electrodialysis	CO2 **[C2]**
6	Activity analysis of precipitated alpha amylase	To check the activity of amylase enzyme precipitated by different methods, analyze the results and report the most efficient method	CO4 **[C4]**
7.	Cell lysis	To perform cell lysis using glass beads	**CO2** [C2]
8.		To perform cell lysis using ultrasonication	**CO2** [C2]

9.		To perform cell lysis using detergent & alkali	**CO2** [C2]
10.	Colum packing & Chromatography	To pack gel permeation column	CO2 **[C2]**
11.		Purification by using size exclusion chromatography	CO3 **[C4]**
12.		Project – Design and develop a fermented product in the lab	CO3 & CO4 **[C4]**

Evaluation Criteria

Components	**Maximum Marks**
Mid-Semester lab-viva/ test	20
End-Semester lab-viva/ test	20
Day to Day performance (Learning laboratory Skills and handling Laboratory Equipments, attendance)	45
Laboratory record	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Principles of Fermentation 3rd edition Technology P. F. Stanbury, A. Whitaker, S. J. Hall Butterworth-Heinemann,2016
2.	Bioprocess engineering: Basic Concepts 3rd edition M. DeLisa, F. Kargi and M.L Schuler; prentice Hall,2017

Course Description

Course Code	**15B17BT573**	**Semester** ODD Semester **(specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** July to December
Course Name	PLANT TISSUE CULTURE LAB		
Credits	1	**Contact Hours**	**2**

Faculty (Names)	**Coordinator(s)**	Dr. Ashwani Mathur
	Teacher(s) (Alphabetically)	Dr. Ashwani Mathur Dr. Smriti Gaur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO372.1	Relate and interpret the role of tissue culture media and it's constituents in micropropagation of ex-plants	C2
CO372.2	Show the effect of media composition and culture conditions on morphogenic responses in ex-plant	C2
CO372.3	(Perform) tests for callus culturing and synthetic seed preparation.	C5
CO372.4	Make use of *in-vitro* propagated plants to study phytocompounds.	C3

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	**Plant Tissue Culture Media**	**Preparation of MS-media and its constituents in micropropogation of plant tissue culture**	CO372.1 / C2
2.	Sterilization Technique	Surface sterilization of plant inoculum	CO372.1 / C2
3.	Seed Germination	In-vitro germination of mustard seeds- Effect of phytohormones on seed germination frequency rate	CO372.2 / C2
4.	Micropropagation	Micropropagation of nodal explant	CO372.1 / C2
5.	Micropropagation	Induction of calli using leaf and internodal explant	CO372.2 / C2
6	Phytocompound Estimation	Determination of total phenolic content	CO372.4 / C3
7.	Cell culture Techniques	To develop suspension culture from callus	CO372.3 / C5
8.	Phytocompound	Extraction of phytocompounds using different solvents	CO372.4 / C3
9	Phytocompound Estimation	Estimation of total soluble Carbohydrate content in plant extract	CO372.4 / C3
10	Phytocompound Estimation	Estimation of total saponins content using vanillin sulphuric acid assay method	CO372.4 / C3
11	Micropropagation	Virtual Lab: Micropropagation & Callogenesis	CO372.2 / C2
12	Synthetic Seed Preparation	Preparation of synthetic seed using plant callus / explant	CO372.3 / C5
Evaluation Criteria			

Components	**Maximum Marks**
Mid-Semester lab-viva/ test	20
End-Semester lab-viva/ test	20
Day to Day performance (Learning laboratory Skills and handling Laboratory Equipments, attendance)	45
Laboratory record	15
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	**Introduction to Plant Cell, Tissue and Organ Culture, *In(ed)* Sunil D. Purohit, PHL Learning Pvt Ltd., 2013**
2.	Plant Tissue Culture- Technique and Experiment, *In (ed)* Roberta H Smith, Academic Press, 2013

Detailed Syllabus
Lab-wise Breakup

Course Code	15B17CI577	**Semester Odd (specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** July to December
Course Name	IT Practice Lab		
Credits	1	**Contact Hours**	LTP 0 0 2

Faculty (Names)	**Coordinator(s)**	Dr Chakresh Kumar Jain
	Teacher(s) (Alphabetically)	Dr Chakresh Kumar Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
C373.1	Explain features of programming environment for Python and Perl	Understand Level (C2)
C373.2	Apply Perl based script for bioinformatics problem	Apply Level (C3)
C373.3	Utilize python programming for pattern finding in biological sequences and explore the app designing	Apply Level (C3)
C373.4	Examine and record the experimental observations	Analyze Level (C4)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	**Computer basics and Environment**	To understand different operating systems and compare them.	**C373.1 C2**
2.	PERL	To understand scalars, arrays and hashes in perl and study its applications.	C373.1 C2
3.	PERL	To understand the use of conditional statements, loops in perl	C373.1 C2
4.	PERL	To understand subroutine in perl and study its applications.	C373.2 C3
5.	PERL	To understand different operators in perl	CO2
6.	PERL	To understand file handling in Perl and study its applications.	C373.2 C3
7.	PERL	To make use of regular expressions of Perl in biological problems.	C373.2 C3
8.	PYTHON	To explore the basics of Python and Installation.	C373.1 C2
9.	PYTHON	To explore the data types, Functions and loops in python.	C373.1 C2
10.	PYTHON	To understand file handling in Python and study its applications.	C373.3 C3
11.	PYTHON	To identify the biological pattern using regular expressions and modules of python	C373.3 C3

12.	PYTHON	To perform the sequence analysis using packages	C373.4 C4
13	App designing	Exploration and basic of App Designing	C373.3 C3

Evaluation Criteria

Components	**Maximum Marks**
Mid Viva (Written exam)	20
Final Viva (Written exam)	20
D2D (Report/Attendance/Experiment)	60
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	M. Model, Bioinformatics programming using Python. Sebastopol, Calif.: O'Reilly Media, 2010**.**
2.	J Tisdall, Mastering Perl for Bioinformatics, O'Reilly Media, 2003

Department of Biotechnology

Programme Name: B.Tech Biotechnology

Semester: V

Course Name & Code: Minor project-I, 15B19BT591

Course Outcomes:

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

Sl. No.	DESCRIPTION	COGNITIVE LEVEL (BLOOM's TAXONOMY)
C350.1	Select a relevant biotechnological problem	C1
C350.2	Summarize research literature related to the identified problem	C2
C350.3	Demonstrate data analysis ability	C2
C350.4	Demonstrate verbal and written presentation and communication skills	C2

Detailed Syllabus
Lecture-wise Breakup

Course Code	16B1NPH534	**Semester: ODD**	**Semester: V Session** 2018 -2019 **Month from:** July to December
Course Name	Bio-Materials Science		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	Dr Papia Chowdhury
	Teacher(s) (Alphabetically)	Dr Papia Chowdhury

COURSE OUTCOMES		**COGNITIVE LEVELS**
C301-13.1	Recall basic fundamental of material structure such as crystal defects, phases etc.	Remembering (C1)
C301-13.2	Demonstrate properties of materials such as mechanical, chemical, surface, optical, magnetic etc.	Understanding (C2)
C301-13.3	Selection of materials based on their properties such as ceramic, metal, polymer, composites etc.	Applying (C3)
C301-13.4	Analyzing the applicability of different biomaterials and listing them according to the applied fields like artificial organs.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Biomaterials and their uses in medical industry**	Classification of biomaterials, Discussion about the need of biomaterials in industry, introduction of bionic man, cyborg. Types of biomaterials applied for the replacement of body parts: pacemakers, mammary prosthesis, heart valves, intracellular lenses, orthopedic implants, fixation, spinal replacement. Implant, Transplant , Prosthesis, their need availability and limitations. Basic ideas of crystal structure and bonding of materials used as biomaterials, elementary ideas of crystal defects and phase changes in biomaterials. Classification: metals, ceramics, polymers, advanced materials, nanomaterials. Length scale of material structures and their uses.	**8**
2.	Mechanical , chemical and optical Properties of Biomaterials	Modulus of elasticity, stress elongation and transfer, wear resistance, Stress-strain relationship, confined and unconfined compression, dynamic shear, pulse wave velocity, electrical and electromagnetic stimulation, stress generated potential (SGP), pulsed electromagnetic field (PEMF), Failure characteristics of materials (Yielding, plastic deformation, creep, fatigue, corrosion wear, impact fracture etc.). Degradation , whiteness and clarity of materials, role of these properties in specific materials for artificial organs Biocompatibility of materials used in artificial organs.	6
3.	Surface properties of Biomaterials	Interface, cohesion, adhesion, Surface energy, contact angles, critical surface tension, thermal treatment of materials, surface improvement (anodization), surface	5

		properties influencing cell adhesion, Young's equation, annealing, quenched materials, Surface reconstruction.	
4.	Magnetic Materials	Concept of magnetic materials used for implantation. Classification – dia-, para-, ferro-, antiferro- and ferri-magnetic materials, their properties and applications; Super-Paramagnetism. Magnetic Storage, biocompatible magnetic materials, basic idea of super conductivity, uses of super conducting diamagnets with focus on MRI.	5
5.	Polymers and Ceramics	Various types of Polymers and their applications (with specific examples of biopolymers); Optical/ Mechanical behavior and Processing of Polymers; Structure, Types, Properties and Applications of Ceramics; Mechanical behavior and Processing of Ceramics. Hydrolysis and its uses. Application of polymers and ceramics in organ replacement.	8
6.	Optical Materials and optical fibers, lasers	Optical materials and their properties for biomedical engineering. Concept of optical fiber and principle of total internal reflection in optical fiber. Single, multistep & graded index fiber. Numerical aperture and Attenuation coefficient. Transmission losses in optical fiber. Uses of optical fibers in medical industry: Endoscopy, Laparoscopy, capsule endoscopy, their benefits and limitations. Optical materials and optical fibers in dentistry. Propagation characteristics of different fibers; Applications of Laser and optical fibers in Biotechnology, laser as medical cutting tool.	8
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Elements of Material Science and Engineering, L.H.Van Vlack, Addison-Wesley 1998
2.	Materials Science and Engineering - An Introduction, W. D. Callister, (Wiley)
3.	A. Beiser, Concepts of Modern Physics, Mc Graw Hill International.
4.	Biomaterials, Sujata V. Bhat, Narosa, New Delhi, 2007

Detailed Syllabus
Lecture-wise Breakup

Subject Code	**19B12HS311**	**Semester: ODD**	**Semester V Session 2019-20** **Month from** July to December
Subject Name	**ENTREPRENEURIAL DEVELOPMENT**		
Credits	**3**	**Contact Hours**	**2-1-0**

Faculty (Names)	**Coordinator(s)**	**Dr Badri Bajaj**
	Teacher(s) (Alphabetically)	**Dr Badri Bajaj**

COURSE OUTCOMES		**COGNITIVE LEVELS**
C303-8.1	Understand basic aspects of establishing a business in a competitive environment	Understand Level (C2)
C303-8.2	Apply the basic understanding to examine the existing business ventures	Apply Level (C3)
C303-8.3	Examine various business considerations such as marketing, financial and teaming	Analyze Level (C4)
C303-8.4	Assessing strategies for planning a business venture	Evaluate Level (C5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Entrepreneurial perspective	Foundation, Nature and development of entrepreneurship, importance of entrepreneurs, Entrepreneurial Mind, Individual entrepreneur Types of entrepreneurs	4
2.	Beginning Considerations	Creativity and developing business ideas; Legal issues; Creating and starting the venture; Building a competitive advantage	7
3.	Developing Marketing Plans	Developing a powerful Marketing Plan, E-commerce, Integrated Marketing Communications	7
4.	Developing Financial Plans	Sources of Funds, Managing Cash Flow, Creating a successful Financial Plan Developing a business plan	6

5.	Leading Considerations	Developing Team, Leading the growing company, Resources for growth	4
Total number of Lectures			**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, Assignment 2, Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Robert D Hisrich, Michael P Peters & Dean A Shepherd, "Entrepreneurship" 10th Edition, McGraw Hill Education, 2018
2.	Norman M. Scarborough and Jeffery R. Cornwell, "Essentials of entrepreneurship and small business management" 8th Edition, Pearson, 2016
3.	Rajiv Roy, "Entrepreneurship", 2nd Edition, Oxford University Press, 2011
4.	Sangeeta Sharma, "Entrepreneurship Development", 1st Edition, Prentice-Hall India, 2016

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B1NHS434	**Semester** Odd **(specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** January to June
Course Name	Principles of Management		
Credits	**3**	**Contact Hours**	(2-1-0)

Faculty (Names)	**Coordinator(s)**	Ms Puneet Pannu (Sect 62) Dr Deepak Verma (Sect 128)
	Teacher(s) (Alphabetically)	Dr Deepak Verma, Ms Puneet Pannu

COURSE OUTCOMES		**COGNITIVE LEVELS**
C303-1.1	Describe the functions, roles and skills of managers and illustrate how the manager's job is evolving	Understand Level (C2)
C303-1.2	Examine the relevance of the political, legal, ethical, economic and cultural environments in global business.	Analyze Level (C4)
C303-1.3	Evaluate approaches to goal setting, planning and organizing in a variety of circumstances.	Evaluate Level (C5)
C303-1.4	Evaluate contemporary approaches for staffing and leading in an organization.	Evaluate Level (C5)
C303-1.5	Analyze contemporary issues in controlling for measuring organizational performance.	Analyze Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Managers and Management	Management an Overview: Introduction, Definition of Management, Role of Management, Functions of Managers, Levels of Management, Management Skills and Organizational Hierarchy, Social and Ethical Responsibilities of Management: Arguments for and against Social Responsibilities of Business, Social Stakeholders, Measuring Social Responsiveness and Managerial Ethics, Omnipotent and Symbolic View, Characteristics and importance of organizational culture, Relevance of political, legal, economic and Cultural environments to global business, Structures and techniques organizations use as they go international .	7
2.	Planning	Nature & Purpose, Steps involved in Planning, Objectives, Setting Objectives, Process of Managing by Objectives, Strategies, Policies & Planning Premises, Competitor Intelligence, Benchmarking, Forecasting, Decision-Making.	5
3.	Organizing	Nature and Purpose, Formal and Informal Organization, Organization Chart, Structure and Process, Departmentalization by difference strategies, Line and Staff authority- Benefits and Limitations-De-Centralization and Delegation of Authority Versus, Staffing, Managerial Effectiveness.	6
4.	Directing	Scope, Human Factors, Creativity and Innovation, Harmonizing Objectives, Leadership, Types of Leadership Motivation, Hierarchy of Needs, Motivation theories,	5

		Motivational Techniques, Job Enrichment, Communication, Process of Communication, Barriers and Breakdown, Effective Communication, Electronic media in Communication.	
5.	Controlling	System and process of Controlling, Requirements for effective control, The Budget as Control Technique, Information Technology in Controlling, Productivity, Problems and Management, Control of Overall Performance, Direct and Preventive Control, Reporting, The Global Environment, Globalization and Liberalization, International Management and Global theory of Management.	5
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Oral Questions)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Robbins S.P., Coulter M & Fernandez A, *Management*, Fourteenth Edition, Pearson Education India (2019)
2.	Robbins S.P., Coulter M & DeCenzo D., *Fundamentals of Management*, Ninth Edition, Pearson Education India (2016)
3.	Durai P., *Principles of Management Text and Cases*, Pearson Education India(2015)
4.	Aryasi A.R., *Fundamentals of Management*, McGraw Hill Education (2018)
5.	Stoner J, Freeman R.E & Gilbert D.R.,Management, Sixth Edition, Pearson Education India (2018)
6.	Weihrich H, Cannice M.V.& Koontz H., *Management A Global, Innovative & Entrepreneurial Perspective*, Fourteenth Edition, McGraw Hill Education (2017)

Detailed Syllabus
Lecture-wise Breakup

Course Code	**16B1NHS 531**	**Semester : Odd (specify Odd/Even)**	**Semester : V Session:2019 -2020** **Month from:** July to December
Course Name	**Sociology of Youth**		
Credits	**3**	**Contact Hours**	**(2-1-0)**

Faculty (Names)	**Coordinator(s)**	**Prof Alka Sharma**
	Teacher(s) (Alphabetically)	**Prof Alka Sharma** **Ms Shikha**

COURSE OUTCOMES		**COGNITIVE LEVELS**
C303-2.1	Understand Youth and youth culture in sociological perspectives	Understanding(C 2)
C303-2.2	Explain the ethical, cultural& social issues concerning Youth	Evaluating(C 5)
C303-2.3	Understand and interpret the youth culture	Analyzing(C 4)
C303-2.4	Analyze societal problems related to youth in the evolving society.	Evaluating(C 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Youth	Meaning, characteristics, Youth for Development, Challenges faced by Youth, Youth's roles and responsibilities in society	2
2.	Youth Culture	Concept of Youth Culture	2
3.	Perspectives on Youth Culture	Functionalist, Conflict, Interactionist and Feminist Perspective on Youth Culture, Youth and Gender	3
4.	Youth Development	Principles of Youth Development, Learning theory, Constructivist theory, collaborative learning , Relationships theories, Theories as a tool to understand Youth Culture	6
5.	Socialization of Youth	Role of family, Community, religion, kin and neighborhood, Changing social structures in family, marriage, Youth and changing identities	6
6.	Emerging problems of Youth	Role and Value conflicts, Generation Gap, Career decisions and Unemployment, Emotional adjustment, Coping with pressures of living, Unequal Gender norms, Crime (Social Strain theories),	6
7.	Changing perceptive of Youth and Youth Culture in 21st century	Role of popular culture and social media, involvement of youth in major decision making institutions, Post-modernity and Youth	3
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**

T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Presentation, Assignment)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Tyyskä, V. *Youth and Society: The long and winding road*, 2nd Ed., Canadian Scholars' Press, Inc. (2008).
2.	White, Rob, Johanna Wyn and Patrizia Albanese. *Youth & Society: Exploring the Social Dynamics of Youth Experience.* Don Mills, ON: Oxford University Press. (2011).
3.	Bansal, P.*Youth in contemporary India: Images of identity and social change*. Springer Science & Business Media. (2012).
4.	Furlong, Andy. *Youth studies: An introduction*. Routledge, (2012).
5.	Blossfeld, Hans-Peter, et al., eds. *Globalization, uncertainty and youth in society: The losers in a globalizing world*. Routledge, (2006).
6.	Ruhela, Satya Pal, ed. Sociology of the teaching profession in India. National Council of Educational Research and Training, (1970).
7.	Frith, S. "The sociology of youth. Themes and perspectives in sociology." Ormskirk, Lancashire: Causeway Books (1984).

Detailed Syllabus
Lecture-wise Breakup

Subject Code	18B12HS311	**Semester ODD**	**Semester** V **Session** 2019-20 **Month from** July to December
Subject Name	STRATEGIC HUMAN RESOURCE MANAGEMENT		
Credits	3	**Contact Hours**	2-1-0
Faculty (Names)	**Coordinator(s)**	Ruchi Gautam (Sec-128), Santoshi Sengupta (Sec-62)	
	Teacher(s) (Alphabetically)	Ruchi Gautam (Sec-128), Santoshi Sengupta (Sec-62)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C303-6.1	Understand human resource management from a strategic perspective and analyze environmental challenges that impact HRM of an organization	Analyze Level (C4)
C303-6.2	Assess the human resource needs of the organization and design recruitment and selection strategies for an organization	Evaluate Level (C5)
C303-6.3	Evaluate the processes of training and development, mentoring, performance management, compensation and reward management in an organization and design effective strategies for the same	Evaluate Level (C5)
C303-6.4	Critically assess career management system, work-life initiatives and other HRM practices of the organization	Evaluate Level (C5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Hours for the module**
1.	Introduction	Role of HR in strategy; Evolution of SHRM; Strategic fit: Conceptual Framework; Theoretical Perspectives on SHRM; SHRM approaches in Indian context	4
2.	Strategic Human Resource Environment and Evaluation	Overview of the environment; SHRM in Knowledge Economy; HRM and Firm Performance; Rationale for HR Evaluation; Approaches to HR Evaluation	4
3.	Strategic Human Resource Planning and Acquiring	Overview of HRP; Objectives of HRP; Job Analysis and SHRM; External and Internal Influences on Staffing; Recruitment: Sources, Methods and Approaches; Selection: Methods and Approaches; Strategic Recruitment and Selection	6
4.	Training, Development, Mentor Relationships	Basic Concepts, Purposes & Significance of Training and Development; HRM Approaches; Linkage between Business Strategy and training; Process; new Developments; Concept and outcomes of mentoring; Strategic approach of Mentoring relationships	4
5.	Strategic Performance Management; Compensations and Reward Management; Career Management	Developing performance management systems; Technology and performance management; Strategic Linkage of performance management; Determinants and approaches of compensation and rewards; New Developments; Business Strategy and compensation; Career Management systems; SHRM approach to career management	6
6.	Work Life Integration and International HRM	HRD Approaches to work-life integration; Development of work-life initiatives; Strategic approach to work-life integration; External HRM; IHRM practices	4
Total number of Lectures			28

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [Assignments (10) Project (10) Attendance (5)]
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Tanuja Agarwala, Strategic Human Resource Management, 1st edition, Oxford University Press, 2007
2.	Stephen J. Perkins, Susan M. Shortland, Strategic International Human Resource Management: Choices and Consequences, Kogan Page, 2010
3.	John storey, Patrick Wright and Dave Ulrich, Strategic Human Resource Management, Routledge Taylor and Francis Group, 2009
4.	Amberg, J. J., & McGaughey, S. L. (2019). Strategic human resource management and inertia in the corporate entrepreneurship of a multinational enterprise. *The International Journal of Human Resource Management*, *30*(5), 759-793.
5.	Stewart, G. L., & Brown, K. G. (2019). *Human resource management*. Wiley.
6.	Deshati E. Social media, a strategic tool for the recruitment process. J Fin Mark. 2017;1(1):3-4.

Detailed Syllabus
Lecture-wise Breakup

Course Code	17B1NHS531	**Semester ODD (specify Odd/Even)**	**Semester V Session** 2019 -2020 **Month from** July to December
Course Name	Technology and Culture		
Credits	3	**Contact Hours**	**2-1-0**

Faculty (Names)	**Coordinator(s)**	Dr Swati Sharma
	Teacher(s) (Alphabetically)	Dr Swati Sharma

COURSE OUTCOMES		**COGNITIVE LEVELS**
C303-5.1	Understand the main theories in cultural management,	Applying (C 2)
C303-5.2	Appraise technological convergence and cultural divergence, relate the differences to the literature and suggest solutions	Evaluating(C 5)
C303-5.3	Interpret and communicate effectively in physical and virtual teams by evaluating appropriate concepts, logic and selecting the apt IT tools.	Evaluating (C5)
C303-5.4	Evaluation of the theoretical knowledge to adapt to cultural differences in global work environment.	Evaluating(C 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction	▪ Genealogy of the concept ▪ The Information Technology Revolution ▪ The concept of Network societies	5
2.	Dimensions of Culture	▪ Evolution of Culture ▪ Principal theories of Culture: Kluckholn and Strodtbeck, Hofstede, Trompenaars and Schwartz ▪ Cultural Diversity and cross cultural literacy	8
3.	Cross cultural communication in physical and virtual teams	▪ The Communication Process ▪ Language and Culture ▪ Non Verbal Communication ▪ Barriers to Cross Cultural Understanding	8
4.	Negotiation and Decision Making	▪ Theories of Negotiation ▪ Negotiation and Intercultural Communication ▪ Decision making in cross cultural environment	2
5.	Cross Culture and Leadership	▪ Leadership and Culture ▪ Theories of Culture centric leadership and their Global Relevance ▪ Developing Competencies for Global citizens ▪ Women as International Leaders ▪ Cross Cultural Training ▪ Ethical Guidelines for Global Citizens	5
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**

T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Assignment and Oral Viva)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Maidenhead.Riding the Waves of Culture: Understanding Cultural Diversity in Business (2012).3rd edition. McGraw Hill.
2.	Edgar, Andrew and Peter Sedgwick (eds.) Key concepts in Cultural Theory. London. Routledge.1999
3.	Gerard Bannon, J. (red.). Mattock, Cross-cultural Communication: The Essential Guide to International Business.2003
4.	Grossberg, L., C. Nelson and P. Treichler (eds.) Cultural Studies. London. 1992
5.	Robertson, Ronald. Globalization: Social theory and global culture, London: Sage, 1992.
6.	Madhavan,S., Cross Cultural Management: Concepts and Cases(2nd Ed),Oxfor University Press 2016.
7.	Coyle,D., The Culture Code: The Secrets of Highly Successful Groups, Bantam, 2018

Detailed Syllabus

Lecture-wise Breakup

Course Code	**16B1NMA531**	**Semester** Odd **(specify Odd/Even)**	**Semester** V **Session** 2019-2020 **Month from** July to December
Course Name	**DISCRETE MATHEMATICS**		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Anuj Bhardwaj	
	Teacher(s) (Alphabetically)	Dr. Anuj Bhardwaj	

COURSE OUTCOMES: After the successful completion of this course, the student will be able to		**COGNITIVE LEVELS**
C301-1.1	explain partial order relations, Hasse diagram, lattices and recursive functions.	Understanding Level (C2)
C301-1.2	solve the difference equations using generating function and Z-transform.	Applying Level (C3)
C301-1.3	explain the propositional and predicate calculus to check the validity of arguments.	Understanding Level (C2)
C301-1.4	demonstrate graphs, digraphs, trees and use it to solve the different problems of graph theory.	Applying Level (C3)
C301-1.5	illustrate various algebraic structures and their properties.	Understanding Level (C2)
C301-1.6	explain the theory of formal languages and solve the related problems of automata.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Relations and Lattices	Relations and their composition. Pictorial representation, matrix and graphical representations. Equivalence relations and partitions. Partial ordered relations and Hasse diagram. Lattices.	5
2.	Functions	Functions and Recursively defined functions, generating functions, solution of recurrence relations by generating function. Z transforms, solution of difference equations by Z transform.	8
3.	Propositional Calculus	Propositions- simple and compound. Basic logical operators. Implication. Truth tables. Tautologies and contradictions. Valid arguments and fallacy. Propositional functions and quantifiers.	4
4.	Graphs	Graphs and related definitions, subgraphs, isomorphism, paths and connectivity. Eulerian graph and Konigsberg problem. Hamiltonian graph. Labelled and weighted graphs. Tree Graphs-Minimum spanning Tree (Prim's algorithm). Graph colorings. Four color problem.	7
5.	Directed Graphs	Trees, Digraphs and related definitions. Rooted trees. Algebraic expressions and Polish notation. Sequential representation. Adjacency matrix. Path matrix.	5

		Shortest path. Linked representation of directed graphs. Binary trees.	
6.	Algebraic Structures	Groups- definitions and examples, order of elements, subgroup, condition for subgroups. Quotient groups, Lagrange theorem and applications, Rings, integral domains and Fields- definition and examples.	7
7.	Languages and Grammars	Strings (words) and languages, grammars, types of grammars, Finite state machines, finite state automata, regular languages and regular expressions.	6
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, Tutorials)
Total	**100**

Recommended Reading material:

1.	Lipschutz, S. and Lipson, M., Discrete Mathematics, 2nd Edition, Tata McGraw-Hill, 1997.
2.	Rosen, K. H., Discrete Mathematics and its Application, 5th Edition, Tata McGraw-Hill, 2003.
3.	Liu, C. L., Elements of Discrete Mathematics, 2nd Edition, Tata McGraw-Hill, 1985.
4.	Kolman, B., Busby, R. C. and Ross, S., Discrete Mathematical Structures, 3rd Edition, Prentice Hall, 1996.
5.	Deo, N., Graph Theory, Prentice Hall, 1980.
6.	Grimaldi, R.P., Discrete and Combinatorial Mathematics, 4th Edition, Pearson Education, 2005.

Lecture-wise Breakup

Course Code	17B1NMA531	**Semester** - Odd	**Semester** V **Session** 2019 -2020 **Month from** July to December
Course Name	Basic Numerical Methods		
Credits	4	**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Prof. Sanjeev Sharma and Dr. Pankaj Kumar Srivastava	
	Teacher(s) (Alphabetically)	Dr. Pankaj Kumar Srivastava, Prof. Sanjeev Sharma, Dr. Yogesh Gupta	

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C301-5.1	explain the concepts of approximation and errors in computation.	Understanding level (C2)
C301-5.2	apply numerical methods for solving algebraic and transcendental equations along with their convergence.	Applying Level (C3)
C301-5.3	explain finite and divided difference formulae for numerical interpolation.	Understanding level (C2)
C301-5.4	apply numerical differentiation and integration in engineering applications.	Applying Level (C3)
C301-5.5	solve a system of linear equations using direct and iterative methods.	Applying Level (C3)
C301-5.6	solve ordinary differential equations using numerical methods.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Approximation and Errors in Computation	Errors, relative error, absolute error, order of approximation.	02
2.	Algebraic and Transcendental Equations	Bisection Method, Regula- Falsi Method, Secant Method, Iterative method, Newton-Raphson Method, convergence, Horner's method	07
3.	Interpolation	Finite Differences, Relation between difference operators, Newton's Forward and Backward Interpolation, Gauss Backward Interpolation, Bessel's and Sterling's central difference operators, Laplace-Everett's formula, Newton's divided difference formula	08
4.	Numerical Differentiation and Integration	Derivatives using Newton's Forward and Backward Interpolation, Bessel's and Sterling's central difference operators, Maxima and minima of a tabulated function. Boole's and Weddle's rule, Romberg's method, Euler-Maclaurin formula, Gaussian Integration.	11
5.	System of Equations	Gauss Elimination method, Given's method, Gauss-Seidel Method, House holder's method.	05
6.	Numerical Solution of Ordinary	Picard's method, Euler's method, Modified Euler's method, Fourth order Runge-Kutta method, Milne's method for fixed order, second order and simultaneous differential equations, Finite-Difference Method	09

	Differential Equations		
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz, Assignments, and Tutorials)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**C. F. Gerald and P. O. Wheatley,** Applied Numerical Analysis, 6th Ed., Pearson Education, 1999.
2.	**M.K. Jain, S.R.K. Iyengar and R. K. Jain,** Numerical Methods for Scientific and Engineering Computation 6th Ed., New Age International, New Delhi, 2014.
3.	**R.S. Gupta,** Elements of Numerical Analysis by 1st Ed., (2009) Macmillan.
4.	**S.D. Conte and C. deBoor,** Elementary Numerical Analysis, An Algorithmic Approach, 3rd Ed., McGraw-Hill, New York, 1980.

Detailed Syllabus
Lecture-wise Breakup

Course Code	15B11EC111	**Semester** Even **(specify Odd/Even)**	**Semester** V **Session** 2019 -2020 **Month from** July to December
Course Name	**Electrical Science -1**		
Credits	4	**Contact Hours**	3+1

Faculty (Names)	**Coordinator(s)**	Ashish Gupta, Madhu Jain
	Teacher(s) (Alphabetically)	Atul Srivastava, Mandeep Narula, Neetu Joshi, Nisha, Rachna Singh, Shraddha Saxena

COURSE OUTCOMES		**COGNITIVE LEVELS**
C113.1	Recall the concepts of voltage, current, power and energy for different circuit elements. Apply the Kirchhoff laws and different analyzing techniques to identify the different circuit parameters.	Apply Level (C3)
C113.2	Define and apply the networks theorems in the complex AC and DC circuits, networks. Demonstrate the physical model for given Sinusoidal AC signal and construct the phasor diagrams.	Applying Level (C3)
C113.3	Demonstrate the conept of resonance and operate different instrumental and measurement equipments.	Understanding Level (C2)
C113.4	Demonstrate the construction and working of single phase transformer.	Understanding Level (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic Concepts	Voltage, Current, Power and Energy analysis for Circuit elements (R, L, C), Independent and Dependent Sources, Kirchhoff's Laws, Voltage Divider rule, Current Divider rule	6
2.	DC Circuit Analysis	Star-Delta Transformation, Source transformation, Mesh and Supermesh Analysis, Nodal and super nodal Analysis	6
3.	Network Theorems	Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem	6
4.	Sinusoidal Steady State Analysis	Physical Model for a Sinusoid, Average Value, Effective Value, Phasor presentation, Addition of Phasor using Complex Numbers, Concepts of impedance and admittance.	4
5.	AC Network Analysis and Theorems	Mesh and Nodal analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem	6
6.	Resonant Circuits	Series and Parallel resonance, frequency response of Series and Parallel resonance, Q-Factor, Bandwidth	4
7.	Electrical Instruments	Essentials of an Instrument, Permanent Magnet Moving Coil (PMMC) Instruments, voltmeter, ammeter, Ohmmeter, Meter Sensitivity (Ohms-Per-Volt Rating); Loading Effect; Multimeter; Cathode Ray Oscilloscope: Construction, Working and Applications. Function Generators	6

8.	Single Phase Transformer	Principle of operation, construction, e.m.f. equation, equivalent circuit, power losses, efficiency (simple numerical problems), introduction to auto transformer.	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment = 10, Quiz = 5, Attendance = 10)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	R.C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 9th ed, John Wiley & Sons, 2013.
2.	Charles K. Alexander (Author), Matthew N.O Sadiku, " Fundamentals of Electric Circuits", 6th ed, Tata Mc Graw Hill, 2019.
3.	Robert L. Boylestad, Louis Nashelsky, " Electronic Devices and Circuit Theory ", 11th ed, Prentice Hall of India, 2014.
4.	D.C. Kulshreshtha, Basic Electrical Engineering,Revised 1st ed, Tata Mc Graw Hill, 2017 .