RK UNIVERSITY

DETAIL TEACHING SCHEME

SCHOOL OF ENGINEERING
PROGRAM: B. TECH – ELECTRICAL ENGINEERING
ACADEMIC YEAR – 2021-22
SEMESTER – V (Batch – 2019-23)
DEFINATION OF CREDIT: **1. Lecture (L):** 1 hour/week/semester, **2. Practical (P)**: 2 hours/week/semester **3. Tutorial(T):** 2 hours/week/semester

TEACHING SCHEME										
Course Code	Course Name	Teaching Hours			SSH	Credits	Audit course	CIE	PSEE	Remarks if any
		Theory	Tutorial	Practical						
EL519	Power Electronics-I	3	0	2	2	4	N	Y	Y	-
EL513	Power System Operation and Control	3	2	2	3	5	N	Y	Y	-
EL516	Electrical Power Utilization and Traction	3	0	0	1	3	N	Y	N	-
EL608	Green Energy Generation & Control	3	0	2	2	4	N	Y	Y	-
EC511	Control System	3	2	2	3	5	N	Y	Y	-
PC501	Rural Internship	-	-	-	-	3	N	Y	Y	-
XXXX	University Elective-III	3	0	0	3/2	3	N	Y	N	-
	Total	**18**	**4**	**8**	**14/13**	**27**				-
	Total Teaching Hours	**30**								-

University Electives-III										
Course Code	Course Name	Teaching Hours			SSH	Credits	Audit course	CIE	PSEE	Remarks if any
		Lecture	Tutorial	Practical						
CD503	Campus to Corporate Training-I	3	0	0	3	3	N	Y	N	-
NEN003	Entrepreneurship Basic	3	0	0	2	3	N	Y	N	-

HOD **Director**

RK UNIVERSITY

DETAIL TEACHING SCHEME

N- No
Y – Yes

CIE – Continuous internal evaluation
PSEE – Practical semester end examination including ITD, Dissertation, Industrial project, Industrial training etc.

SSH - Self-study hours per week

Remarks: *******Students are required to undergo 15 hrs. training / field visit / workshop in relevant field during semester.*

HOD **Director**

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SYLLABUS

Course Title	**Power Electronics-I**
Course Code	**EL519**
Course Credit	Theory :03
	Practical :01
	Tutorial :00
	Credits :04

Course Learning Outcomes:

At the end of the session student will be able to:

- **Identify** the importance of power electronics in industry.
- **Recognize** basic operation and application of various power semiconductor devices.
- **Acquire** basic understanding of various power converter modules used to build power electronics system.
- **Analyze** the performance parameters of controlled & uncontrolled rectifier circuit and DC to DC regulators.
- **Acquire** the ability to select and design suitable power converter modules/system in order to meet requirements of industrial applications.
- **Develop** hands-on experience in designing, testing, and debugging power electronics circuits

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Power semiconductor devices** **Power MOSFET:** Structure, static V-I characteristics, Ratings, Maximum allowable ratings, safe operating area, applications. **GTO:** Structure, Equivalent Circuit, V-I characteristics, Ratings, Maximum allowable ratings, applications. **IGBT:** Structure, static V-I characteristics, ratings, Maximum allowable ratings, Latch up, safe operating area, applications. **SIT, MCT, SITH, UJT, TRIAC and DIAC-** Symbol, V-I characteristics and applications. **Switch Realization-** Switch Applications- Single-Quadrant Switches, Current-Bidirectional Two-Quadrant Switches, Voltage-Bidirectional Two-Quadrant Switches, Four-Quadrant Switches, Synchronous Rectifiers.	**07**
2.	**Thyristor**	**08**

	Basic structure and Operation, Static V-I characteristics, Thyristor turn ON methods- Forward triggering, Gate triggering, dv/dt triggering, temperature triggering and light triggering. Switching Characteristic of Thyristor, Thyristor Gate characteristics, Two Transistor Model of Thyristor, Thyristor rating, Thyristor Protection- Snubber Circuit Design- Over Voltage Protection, Overcurrent Protection and Gate Protection. Improvement of Thyristor Characteristics, Heating and Cooling of Thyristor, Series and parallel operation of thyristors. **Commutation Circuit-** Natural Commutation, Forced commutation: load commutation, impulse commutation, resonant pulse commutation, complementary commutation and line commutation.	
3.	**Gate and Base Drive Circuits** MOSFET gate drive circuits, BJT base drive circuits, Isolation of Gate and Base drive circuits, Pulse transformers, Opto-couplers, Thyristor firing circuit (R and RC Triggering circuit), Gate drive circuit of unijunction transistor (UJT), Gate drive ICs.	**05**
	Total	**21**
	SECTION-II	
4.	**AC to DC converters** Principle of Phase Control, Single Phase Half Wave, Full Wave Controlled and Uncontrolled Converters with R, RL, RLE and LC loads, Effect of Freewheeling Diode, Semi-converters. Three-phase thyristor converter- $3-\phi$ half wave-controlled converter with R load and RL load. $3-\phi$ full wave converters, performance parameters of $3-\phi$ full converters. Effect of source impedance on the performance of the converters, dual converter.	**10**
5.	**DC to DC Converters** Principle of chopper operation, Control strategies, Step-up chopper, Types of chopper circuit- First quadrant (class-A), Second quadrant (class-B), Two quadrant (class-C), Class-D, Four quadrant (class-E). Steady State-Time Domain analysis of Type-A chopper, Concept of multiphase chopper. **DC-DC switched mode regulator-** Buck regulator, Boost regulator, Buck-Boost regulator, Cuk regulator, Full-bridge regulator. **DC-DC switch mode regulator with isolation-** Introduction to switched mode power supply- Fly back regulator, forward regulator, push pull regulator, Half-bridge regulator, full bridge regulator.	**11**
	Total	**21**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.

- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Minimum ten experiments shall be there in the laboratory related to course contents.

Reference Books:

1. M.H. Rashid "*Power Electronics"*, P.H.I. /Pearson
2. Ned Mohan, Tore M. Undeland "*Power electronics: converters, applications, and design"* John Wiley & Sons
3. P. S. Bimbra "*Power Electronics"* Khanna Publishers.
4. M. D. Singh and Khanchandani K. B. "*Power Electronics"* T.M.H

Additional Resources

NPTEL Videos Lecture Series

- A Course on Power Semiconductor devices-http://nptel.ac.in/courses/108105066/
- A Course on Power Electronics- http://nptel.ac.in/courses/108101038/

Course Title	**Power System Operation and Control**
Course Code	**EL513**
Course Credit	Theory :03
	Practical :02
	Tutorial :02
	Credits :05

Course Learning Outcomes:

At the end of the course students will be able to-

- **Describe** different computer techniques to control power system.
- **Use** matrix and power system properties to simplify and speedy evolution of the analysis.
- **Employ** computer techniques to determine various power system studies.
- **Analyze** various power system controls, monitoring and its solution.
- **Formulate** numerical methods and use software packages to determine power flow and voltage levels in power systems.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**The Admittance and Impedance Model and network Calculations** Incidence matrices, Primitive networks, Formation of network matrices- Singular transformation and direct inspection method, Successive elimination, Node elimination, Triangular factorization, Sparsity, Algorithm for formation of bus impedance matrix, Modification of bus impedance matrix for change in the network- Type1,2,3 and 4 modifications, Numerical.	**08**
2.	**Power Flow Analysis** Need of load flow, Bus classification, development of the load flow equation, Formulation of power flow problems – Power flow solution using Gauss Seidel method, Newton Raphson method (Polar, Rectangular form), Decoupled, Fast Decoupled load flow, Flow chart, Algorithm and comparison of power flow solution techniques, Numerical, regulating transformer, Phase shifting transformer.	**13**
3.	**Computer control of power systems** Need for computer control of power systems, Concept of energy control centre and the functions- system monitoring - data acquisition and control,	**07**

	System hardware configuration – SCADA and EMS functions, Network topology - state estimation - security analysis and control, Various operating states (Normal, alert, emergency, in-extremis and restorative), State transition diagram showing various state transitions and control strategies, Communication protocols.	
		Total **28**
	SECTION-II	
4.	**Power System Stability** Introduction Steady state, dynamic and transient's stability, Swing equation, equal area criterion, solution of swing equation using step by step method modified Euler's method and Runge-Kutta method, methods of improving transient stability, SMIB, MMIB systems.	**14**
5.	**Control of Generation** Introduction, Basics of speed governing mechanism and modelling-speed load characteristics, Necessity of maintaining frequency constant, Load frequency control, Generator Model, Load Model, prime -mover model, Governor model, Control area concept, Tie-line Model and tie-line control.	**14**
		Total **28**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

Reference Books:

1. I. J. Nagrath, D. P. Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Co. Ltd.
2. N.V. Ramana, "Power System Operation and Control", Dorling Kindersley (India) Pvt. Ltd.
3. S.Sivanagaraju, G. Sreenivasan, "Power System Operation and Control",", Dorling Kindersley (India) Pvt. Ltd.
4. Allen J. Wood, Bruce F. Wollenberg*"Power Generation, Operation, and Control"*, Wiley India Edition 2003.
5. *"Electrical Power System Handbook"*, IEEE Press
6. Olle I. Elgerd, *"Electrical Energy System Theory"*, 2nd Edition, Tata McGraw Hill Publishing Co. Ltd.
7. Prabha Kundur , *" Power system stability and control"*, Tata McGraw Hill
8. T. K. Nagsarkar and M. S. Sukhija, *"Power System Analysis",* Oxford University Press.
9. John J. Grainger and William D. Stevenson, *"Power System Analysis"*, Tata McGraw-Hill.

10. N.V. Raman," *Power System Operation and Control",* Pearson Education India, 2010.

Additional Resources

- A Course on Introduction to Power System Analysis- http://nptel.ac.in/courses/108105067/
- A Course on Modern Power Systems- http://nptel.ac.in/courses/108101040/
- A Course on Power System Operation & Controlhttp://nptel.ac.in/courses/108104052/

Course Title	**Electrical Power Utilization & Traction**
Course Code	**EL516**
Course Credit	Theory :03
	Practical :00
	Tutorial :00
	Credits :03

Course Learning Outcomes:

At the end of the course, the students will be able-

- **Understand** applications and effective utilization of electric energy.
- **Design** the illumination system.
- **Apply** the utility of electrical heating.
- **Realize** the working of electric traction system.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Fundamentals of illumination:** Nature of light, term used in illumination, source of light. Various illumination methods: Types of source of illumination, gaseous discharge lamp, fluorescent lamp, LED, OLED. Types of lighting scheme: direct lighting scheme, semi-direct lighting scheme, indirect lighting scheme, semi-indirect lighting scheme, general lighting scheme. Design of lighting scheme- Street lighting, Factory Lighting, Flood lighting, Methods of lighting calculations.	**10**
2.	**Refrigeration, Air Conditioning and Electrolysis Process:** Refrigeration, principle of refrigerator, refrigerant, vapor compression refrigeration cycle, electric circuit of refrigerator, common faults in refrigerator, application of refrigeration. Air Conditioning: Temperature control, humidity control, air movement and air conditioning, electric circuit of air conditioner, room air conditioner. Electrolysis Process: Faraday's Laws and applications	**11**
	Total	**21**
	SECTION-II	

3.	**Electric Traction:** Introductions, Different traction systems, Various system of electric traction. Locomotives, Tramways, trolleys, Track electrification, Comparison between A. C and D. C systems of railway electrification, Types of speed and speed-time curves, Examples. Mechanic soft rain movement, Tractive effort, power, Output, examples, Energy output from driving axles, Energy output using simplified speed-time curves, Examples, Factors affecting energy consumption, dead weight, accelerating weight, Adhesion weight, examples., Traction motors and their characteristics.	**16**
4.	**Electrical Heating:** Introduction, Classification of electric heating methods, Resistances heating methods, Requirements of heating elements, Problems, Induction heating: principle, types of induction furnaces-Direct core type, Vertical core type, Indirect core type, Core less type, advantages and disadvantages.	**05**
	Total	**21**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

Reference Books:

1. **Electrical Power Systems** by S.L Uppal, S Rao, Khanna Publications.
2. **Utilization of Electrical Power and Electric Traction** by J. B. Gupta, S. K. Kotharia and Sons.
3. **Electric Power Utilization** by R. K. Garg.
4. **Electrical Power Utilization** by B. L. Tereja, S Chand Publication.
5. **Electrical Power Utilization** by O. Taylor, Longman Publications.

Additional Resources

- NPTEL Video Lecturers
- https://www.youtube.com/watch?v=tnHRpCsm160
- Website for Products & Services for TRAXX- Electric Locomotive- http://www.bombardier.com/en/transportation/products-services/rail-vehicles/locomotives/traxx.html
- Website For Diesel Electric Shunting Locomotives http://www.bhel.com/product_services/product.php?categoryid=42
- Website for Traction- https://www.bhelbpl.co.in/traction/traction_main_new.htm

Course Title	Green energy generation and control
Course Code	EL608
Course Credit	Theory :03
	Practical :01
	Tutorial :00
	Credits :04

Course Learning Outcomes:

At the end of the session student will be able:

- **Describe** the basics of solar PV and solar thermal system.
- **Explain** working of standalone and grid connected PV system.
- **Analyze** the factors affecting the performance of solar cell output.
- **Identify** the components of Wind Energy conversion system.
- **Describe** working and performance of different hybrid energy system.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Introduction** Global warming, CO2 emission by conventional power generation plants, needs for green energy generation, worldwide demand of energy and supply capacity (for current, past and future). Introduction to different types of green energy generation.	03
2.	**Photovoltaic Energy Conversion** Principles of Solar Radiation, Principle and types of Photovoltaic cell, thermal characteristics, mechanical strength, efficiency and power rating. Solar cell Types, Solar Energy Collection:	**04**
3.	**PV Systems** Stand-Alone PV Systems, Consumer Applications, Solar Home Systems, Grid-Connected PV Systems, Decentralized Grid-Connected PV Systems, Central Grid-Connected PV Systems Inverter. Installation Possibilities, Geometrical Considerations, PV Systems in Connection with Buildings, Advantages and Potential, Installation on the Roof, Solar Power Plants.	**08**

4.	**Efficiency and Performance of PV Systems** Stand-Alone PV Systems, Grid-Connected PV Systems, Possibilities of Quality Control and Control of Energy Yield of Grid-Connected PV Systems, Solar Module, Inverter, Mounting Racks and Fixing Materials Cables, Electric Safety of Grid-Connected PV Systems, PV Markets Support Measures and Costs, Market Survey. Cost of Photovoltaics, Cost of PV Modules, Cost of PV Systems, Cost of Power Production.	**06**
	Total	**21**
	SECTION-II	
5.	**Wind Energy** Sources and potentials, site selection. Horizontal and vertical axis windmills their performance & characteristics, Betz criteria, different types of Generators used, converters & control used, Lightning protection of wind tower, small wind turbine concept.,	**07**
6.	**Bio-Mass** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects	**06**
7.	**Hybrid system** Wind –solar, wind Diesel etc. Working Principal, performance calculation. Government policy. Present scenario. Operating schedule, Introduction to software used for simulation of Hybrid system.	**04**
8.	**Ocean Energy** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and Conversion techniques, mini-hydel power plants, and their economics. **MHD power concept.**	**04**
	Total	**21**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

Reference Books:

1. ***Non – Convectional Energy sources*** by. G. D. Rai, Khanna Publishers.
2. ***Wind Electrical Systems*** *by D. Kastha, S.N. Bhadre, Oxford University Press.*
3. ***Non - Conventional Energy Systems*** by K Mittal and Wheeler

4. BH Khan “Non-conventional energy sources” Tata Mc Graw-Hill Publishing company limited.
5. Chetan Singh Solanki, “Solar Photovoltaics *Fundamentals, Technologies and Applications*”, PHI Publication, ISBN-978-81-203-3760-2, 2009.
6. MukundR. Patel, “Wind and solar systems”, CRC Press, ISBN 0-8493-1605-7, 1999.
7. S. Rao, B.B. Parulekar, “Energy Technology : Nonconventional, Renewable & Conventional”, Khanna Publishers, ISBN 10:8174090401, 2009

Additional Resources

- http://geda.gujarat.gov.in/

Course Title	**Control System**
Course Code	**EC511**
Course Credit	Theory :03
	Practical :01
	Tutorial :01
	Credits :05

Course Learning Outcomes:

After completion of this course the student is able to-

- **Derive** the transfer function of physical systems and determination of overall transfer function using block diagram algebra and signal flow graphs.
- **Determine** time response specifications of second order systems and to determine error constants.
- **Analyze** absolute and relative stability of LTI systems using Routh's stability criterion and the root locus method.
- **Analyze** the stability of LTI systems using frequency response methods.
- **Design** Lag, Lead, Lag-Lead compensators to improve system performance from Bode diagrams.
- **Apply** various control strategies to different applications (example: Power systems, electrical drives etc.)
- **Test** system Controllability and Observability using state space representation and applications of state space representation to various systems.

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**Introduction:** Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations – Impulse Response and transfer functions – Translational and Rotational mechanical systems.	**07**
2.	**Transfer Function Representation:** Transfer Function of DC Servo motor – AC Servo motor- Synchro transmitter and Receiver, Block diagram	**07**

	representation of systems considering electrical systems as examples – Block diagram algebra – Representation by Signal flow graph – Reduction using mason's gain formula.	
3.	**Time Response Analysis:** Standard test signals – Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications – Steady state response – Steady state errors and error constants – Effects of proportional derivative, proportional integral systems.	**07**
	Total	**21**
	SECTION-II	
4.	**Stability Analysis:** The concept of stability – Routh stability criterion – qualitative stability and conditional stability. **Root Locus Technique:** The root locus concept – construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci. **Frequency Response Analysis:** Introduction, Frequency domain specifications-Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain Margin-Stability Analysis from Bode Plots.	**09**
5.	**Stability Analysis in Frequency Domain:** Polar Plots, Nyquist Plots and applications of Nyquist criterion to find the stability – Effects of adding poles and zeros to G(s)H(s) on the shape of the Nyquist diagrams. **Classical Control Design Techniques:** Compensation techniques – Lag, Lead, and Lead Lag Controllers design in frequency Domain, PID Controllers.	**06**
6.	**State Space Analysis of Continuous Systems:** Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and its Properties.	**06**
	Total	**21**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Seminar/ will be conducted.

Reference Books:

1. “Katsuhiko Ogata”, “Modern Control Engineering”, Prentice Hall India, 2002.
2. “I. J. Nagrath and M. Gopal”, “Control Systems Engineering”, New Age International (P) Limited, Publishers, 5th edition, 2009.
3. “B. C. Kuo”, “Automatic Control Systems”, John wiley and sons, 8th edition, 2003.
4. “A. Nagoor Kani” , “Control Systems”, RBA Publications,2nd Edition,2009.

Additional Resources

- Website Of Virtual lab for Control System Design- http://vlcsd.virtual-laboratories.com/
- Website Of Sakshat Virtual Lab For Magnetic Levitation System- http://iitb.vlab.co.in/?sub=8&brch=117&sim=959&cnt=2016
- Control Systems Tutorial- https://www.tutorialspoint.com/control_systems/index.htm

Course Title	RURAL INTERNSHIP
Course Code	PC501
Course Credit	03

Outcomes:

At the end of the course students will be able to:

- **Identify** social commitment by examining it from society perspective.
- **Learn** and **identify** real life problems from the site/society.
- **Analyze** identified problem and **propose** solution.
- **Conduct survey** on societal need, safety, health and technology front.

Pedagogy

A student is required to undergo 2 weeks of Rural Internship generally at the end of the second year of the B. Tech. Program as partial requirement for the award of the degree with assistance from Non-Governmental Organization.

A student's social commitment, under supervision in a well-administered agency, office, industry or organization should be commensurate with his or her level of education and future career goals. While the evaluation of the student's performance in the internship is based primarily on academic criteria, the practical experience, prospective critical challenges of an era, and learning about one's ability to function in a given occupational environment is prime focus.

Course: B. Tech II year Summer All branches

Duration: 2 weeks

Rules and Regulations

- Interns are expected to keep an internship diary that will provide them, the Village/NGO representative with an accounting of the intern's activities.
- The internship diary will also provide the basis for keeping track of the intern's time, the progress toward meeting the Learning objectives, and as a reference for some of the course assignments.
- The daily log entries should describe activities and the student's reflections concerning those activities and the experiences.
- The internship is 2 weeks and it is compulsory for graduation.
- The assessment form should be completed by the Village/NGO supervisor at the end of the Internship.
- If there is any doubt as to whether a student may have falsely completed the diary or made false declarations about the village/community, the supposedly completed training will be disqualified.
- This diary should include original knowledge gained from site or office rather than practical knowledge obtained from books or lecture notes.
- The student is advised to take photographs, plans, specifications and detailed analysis etc. to support his or her internship report with prior permission.
- The log should have an entry for each day that a student works hour at her or his internship. Each entry should contain:

- The date.
- Hours worked (time in and time out).
- A description of that day's activities and
- Reflections about how that day's activities connect with/contribute to meeting one's objectives and/or what one learned.

Course Title	Campus to Corporate Training – 1
Course Code	CD503
Course Credit	Theory :03
	Practical :00
	Tutorial :00
	Credits :03

Course Learning Outcomes:

At the end of the course, students will be able to-

- **Formulate** the problem quantitatively and use appropriate arithmetical, and/or statistical methods to solve the problem.
- **Recall** Formulae.
- **Demonstrate** various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
- **Interpret** quantitative information (i.e., formulas, graphs, tables, models, and schematics) and draw implications from them.
- Critically **evaluate** various real-life situations by resorting to analysis of key issues and factors.

Detailed Syllabus

Module	Name of chapter & details	Hours Allotted
	Quantitative Ability	
1.	Numbers, H.C.F. & L.C.M., Simplification, Decimal Fractions:	**04**
2.	Square & Cube roots, Average, Profit & Loss:	**05**
3.	Simple Interest, Compound Interest:	**04**
4.	Permutations & Combinations, Probability, Ratio & Proportion:	**05**
5.	Problems on Age, Time and Work:	**03**
6.	Odd man, Clocks, Calendar:	**03**
7.	Time & Distance, Problems on Trains, Boats & Streams:	**04**
8.	Tabulation, Bar graphs, Pie graphs & Line graphs:	**04**

Logical Verbal Reasoning		
9.	Character Puzzles, Series Completion, Venn Diagrams:	**03**
10.	Seating Arrangement, Blood Relation Test:	**03**
11.	Logical Sequence of Words, Classification:	**02**
12.	Data Sufficiency, Syllogism:	**02**
13.	Analogy, Arithmetic Reasoning, Direction Sense Test	**03**
	Total Hours	**45**

Instructional method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, blackboard, Classroom Teaching & Learning Activities etc.
- Though the majority of the class will be lecture, certain skill building exercises will be introduced to expose the students to increasingly more difficult content.
- Assessment will be conducted every week on content delivered during week.

Reference Books

1. Dr. R.S. Aggarwal, “Quantitative Aptitude”, S. Chand Publication, New Delhi.
2. Abhijit Guha, “Quantitative Aptitude for Competitive Examinations”, 4th Edition.
3. Dr. R. S Agarwal, “A Modern Approach to Verbal & Non-Verbal Reasoning”, S. Chand Publication, New Delhi.
4. Arun Sharma, “How to Prepare for Logical Reasoning for the CAT”

Additional Resources

- Website for Interview Questions & Answers- www.indiabix.com
- Online Job Portal- www.freshersworld.com

Course Title	**Entrepreneurship Basic**
Course Code	**NEN003**
Course Credit	Theory :03
	Practical :00
	Tutorial :00
	Credits :03

Course Learning Outcomes:

After Successful completion of the above course, students will be able to:

- **Understand** the fit between them and their entrepreneurial ambitions
- **Identify** their customers.
- **Develop** a solution for their customers' problems.
- **Create** Business Model and MVP fit to market.
- **Build** and **Demonstrate** the MVP**.**

Detailed Syllabus

Sr. No.	Name of chapter & details	Hours Allotted
	SECTION-I	
1.	**GET STARTED**: Discover Yourself Find your flow, Effectuation, Case Study: Tristan Walker: The extroverted introvert, Identify your entrepreneurial style	**5**
2.	**IDEA/PROBLEM**: Identify Problems Worth Solving What is a business opportunity and how to identify it, Find the problems around you that are worth solving, Methods for finding and understanding problems – (Observation, Questioning, DT, Jobs to be done (JTBD)), How to run problem interviews to understand the customer's world view, Introduction to **Design Thinking** - Process and Examples, Generate ideas that are potential solutions to the problem identified – **DISRUPT**, Class Presentation: Present the problem you "love", Form teams	**4**
3.	**CUSTOMER:** Identify Your Customer Segments and Early Adopters The difference between a consumer and a customer (decision maker); Market Types, Segmentation and Targeting, Defining the personas; Understanding Early Adopters and Customer Adoption Patterns, Identify the innovators and early adopters for your startup Craft Your Value Proposition	**6**

	Come up with creative solutions for the identified problems, Identify the UVP of your solution using the Value Proposition section of the VPC, Class Presentation: Communicating the Value Proposition- 1 min Customer Pitch	
4.	**BUSINESS MODEL**: Get Started with Lean Canvas Basics of Lean Approach and Canvas; Types of Business Models (b2b; b2c), Intro to Risks; Identify and document your assumptions (Hypotheses); Identify the riskiest parts of your plan, Class Presentation: Present your Lean Canvas	**4**
5.	**VALIDATION**: Develop the Solution Demo Build solution (mockups) demo, how to run solution interviews, GOOTB: Run Solution interviews, does your solution solve the problem for your customers: The problem-solution test. **Sizing the Opportunity** Differences between a Startup venture and a small business; Industry Analysis: Understanding what Competition is and it's role, Analyze competition. **Building an MVP** Identify an MVP and build it - I; Document and validate your assumptions, How to do MVP Interviews, GOOTB: Run MVP interviews, Is there a market for your product --The product-market fit test, Class Presentation: Present your MVP.	**8**
6.	**MONEY**: Revenue Streams • Basics of how companies make money, understand income, costs, gross and net margins, Identify primary and secondary revenue streams. Pricing and Costs • Pricing and Costs, Value, price, and costs; Different pricing strategies, Understand product costs and operations costs; Basics of unit costing. • Financing Your New Venture • How to finance business ideas, Various sources of funds available to an entrepreneur and pros and cons of each, what investors expect from you, Practice Pitching to Investors and Corporate.	**5**
7.	**TEAM**: Team Building Shared Leadership, Role of a good team in a venture's success; What to look for in a team; How do you ensure there is a good fit? Defining clear roles and responsibilities, Explore collaboration tools and techniques - Brainstorming, Mind mapping, Kanban Board	**6**
8.	**MARKETING & SALES**: Positioning Understand the difference between product and brand and the link between them, Define the positioning statement for your product/service and how it should translate into what your customers should see about that brand in the marketplace. Channels & Strategy.	**3**

	Building Digital Presence and leveraging Social media, creating your company profile page, Measuring the effectiveness of selected channels. Sales Planning Understanding why customers buy and how buying decisions are made; Listening skills, Unique Sales Proposition (USP); Art of the sales pitch (focus on customers' needs, not on product features), Follow-up and closing a sale; Asking for the sale.	
9.	**SUPPORT**: Planning & Tracking Importance of project management to launch and track progress, Understanding time management, workflow, and delegation of tasks. Business Regulation Basics of business regulations of starting and operating a business; Importance of being compliant and keeping proper documentation, how to find help to get started.	**4**
10.	**Capstone Project:** Present Your BMC (Optional - and MVP)	
	Total	**45**

Instructional method and Pedagogy:

- At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
- Lectures will be conducted with the aid of multi-media projector, use of White Board, OHP etc.
- Attendance is compulsory in lectures and laboratory.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Quizzes will be conducted.

Reference Books:

1. Traction : A Startup Guide to Getting Customers by Gabriel Weinberg and Justin Mares.
2. Strategize, Test, Measure: The Bullseye Framework by Brian Balfour of Elevate-Growth and User Acquisition.
3. The 50% Rule for Traction by Ash Maurya.
4. Six Keys to Release Ideas for Profitable Growth: Corporate Entrepreneurship by Hakan Ener, HBR, December 2014.

Additional Resources

- Read Forbes article and do Group Discussion https://www.forbes.com/sites/chrismyers/2015/12/16/find-your-flow-and-success-will-follow/
- https://necrophone.com/2014/01/20/effectuation-the-best-theory-of-entrepreneurship-you-actually-follow-whether-youve-heard-of-it-or-not/

- "Understand the Customer Problem by GOOTB": https://www.youtube.com/watch?v=sEENIZgscDw
- Prof. Clay Christensen "Identifying Customer Needs" https://www.youtube.com/watch?v=yVCZ-7xSsCw
- Value Proposition & Customer Need: https://www.youtube.com/watch?v=6FnG8pJL8yM&index=3&list=PLw540Wq5kay866m6A6xI7KOwE_Ah7is4m
- Ash Maurya -Capture your BMC in 20 minutes https://www.youtube.com/watch?v=7o8uYdUaFR4&t=462s

Assessment Model

- Assignments and Class Participation-30%
- Quizzes - 10%
- Final Exam – 30%
- Capstone Project – 30%