

UNIVERSITY OF MUMBAI



Syllabus for the S.Y.B.Sc.

Program: B.Sc.

Course: AERONAUTICS

(AVIONICS STREAM)

(Credit Based Semester and Grading System with
effect from the academic year 2012–2013)

AERONAUTICS (AVIONICS STREAM) Syllabus
Credit Based and Grading System
To be implemented from the Academic year 2012-2013

SEMESTER III

Course Code	UNIT	TOPICS	Credits	L / Week
USARA301	I	AIRFRAME AND SYSTEMS, THEORY OF FLIGHT, LANDING GEAR	3	1
	II			1
USARA302	I	AIRCRAFT ELECTRICAL SYSTEM	3	2
	II			2
USARA303	I	DIGITAL ELECTRONICS	3	4
USARA304	I	AIRCRAFT RADIO COMMUNICATION	3	2
	II			2
USARA305	I	AIRCRAFT INSTRUMENT SYSTEM	3	4
USARAP301	AIRFRAME AND SYSTEMS, THEORY OF FLIGHT, LANDING GEAR		2	2
	AIRCRAFT INSTRUMENT SYSTEM			2
USARAP302	AIRCRAFT ELECTRICAL SYSTEM		3	2
	DIGITAL ELECTRONICS			2
	AIRCRAFT RADIO COMMUNICATION			2

SEMESTER III

Course Code	Title	Credits
USARA301	AIRFRAME AND SYSTEMS, THEORY OF FLIGHT, LANDING GEAR	3 Credits (40 lectures)
<p>Unit I : Theory of Flight Performance of aircraft, take-off, climb, Power curves – Propeller propulsion, horizontal flight, effect of changes of engine power, effect of altitude on power curves, Ceiling, effect of weight on performance, influence of Jet propulsion on performance. Acceleration, loads during turn, angle of bank, Aerobatics, Inverted maneuvers. Stability & control, Lateral, Longitudinal & directional stability, effect of wing shape, position & type on stability, Control of an airplane.</p>		20 Lectures
<p>Unit II : Landing gear Construction of Landing Gear, retractable & non-retractable landing gears, Nose & tail gears, Construction of shock absorbers, Function & Maintenance of shock cords, Spring steel struts, Air -oil Oleo struts, Struts spring steel struts, Anti-skid assemblies, Shimmy dampers, Safety devices and indications. Landing gear mechanisms, warning and safety devices, Operations, Landing gear brakes, Power & boost brake systems, inspection after heavy landing and over weight landing.</p>		20 Lectures
<p>TEXT BOOKS – 1. Mechanics of Flight (11th Edition) by A.C.KARMODE (Ch – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12) – PEARSON EDUCATION Pvt. Ltd. 2. Airframe and Power plant Mechanics Airframe Handbook (AC65 – 15A) (Ch – 9) – SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.</p>		

Course Code	Title	Credits
USARA302	AIRCRAFT ELECTRICAL SYSTEM	3 Credits (70 lectures)
<p>Unit I : DC Generators – theory & construction, type of DC generators, series, shunt & compound wound generators, characteristics of DC generators, armature reaction & its compensation, commutation inter-poles etc., DC voltage regulators basic principle, type of regulators, Vibrator & carbon pile type, equalizing circuits, current limiters etc., RC relay, Differential RC relays, starter generators & its controls, paralleling of DC generators, aircraft buses & protective devices, maintenance of DC generators & RC relays, generator control unit functions, trouble shooting of generator system.</p>		35 Lectures
<p>Unit II : DC motors – theory & construction, different type of DC motors, Characteristics of different type of DC motors, counter EMF, continuous & intermittent duty motors, reversible DC motors as applicable to aviation use, reversing the direction of rotation of DC motors, brakes & clutches for motors, limit switches & protective devices of motors as applicable for aviation use. Linear & rotary actuators for aviation use, energy losses & speed control and speed & torque characteristic of DC motors, Motor starters, inspection & maintenance of DC motors.</p>		35 Lectures

TEXT BOOKS –

1. Aircraft Electricity and Electronics by EISMIN (Ch – 10)
2. Examples in Electrical Calculation by ADMIRALTY (BR158) (Ch – 13, 14, 15, 16, 17, 18, 19)
3. Electrical Technology by B.L.THERAJA (Ch – 21, 22, 23, 24, 25, 26)

Course Code	Title	Credits
USARA303	DIGITAL ELECTRONICS	3 Credits (70 lectures)
<p>Unit I : Digital Principles:- Analog & digital signals, wave forms, circuits, voltage levels, switching time, storing of digital information. Digital Logic:- Basic gates, NOT, OR, AND, Universal gates - NAND, NOR, AND –OR -Invert gates, positive & Negative logic, Trouble shooting devices Combinational & sequential logic circuit. Boolean laws & Theorems, SOP method , fundamental products, Truth table, to karnaugh map, pairs, quads octets, karnaugh map simplifications, don't care conditions, POS method & simplification Data Processing circuits. Serial & parallel data transmission multiplexers, working & applications. De multiplexer – working and its application. Number systems & codes:- Binary system , conversion binary to decimal, decimal to binary , octal numbers , conversion from octal to decimal, decimal to octal, octal to binary, binary to octal, whole number & fractional conversion, hexadecimal number system, conversion of hex to binary & decimal; vice versa. BCD, excess -3, gray, ASKII codes and applications. Arithmetic circuits: - Binary, addition, subtraction, multiplication, division laws, with examples, ones & twos complements, Half & full adder circuits. Clocks and timing circuit: - TTL clock, wave forms, requirements of clock, Schmitt Trigger. Flip Flops: - Flip flop introduction. Types of flip flop. R.S. Flip flop, Gated flip flops, Edged triggered R.S, D, J-K flip flop, principles, JK master & slave flip flop working. Integrated circuits: - Classification, construction, application digital TTL logic circuits mosfet devices, TTL devices.</p>		70 Lectures
<p>TEXT BOOKS –</p> <ol style="list-style-type: none"> 1. Digital Principles and Applications by DONALD P. LEACH, ALBERTPAUL MALVINO, GOUTAM SAHA (Ch – 1, 2, 3, 5, 6,7,8 & 14) – TATA McGRAW HILL COMPANIES 		

Course Code	Title	Credits
USARA304	AIRCRAFT RADIO COMMUNICATION	3 Credits (70 lectures)
<p>Unit I: Basic electronics, calculations of resonant frequency, effect of resonant frequency on impedance. Resistors, Series & parallel circuits, Diodes, P & N type material, Transistors & its application, Operation & amplifier stages, Positive & negative feedback.</p>		35 Lectures
<p>Unit II: Radio theory, Modulation & demodulation, amplitude modulation, Balanced modulator, AM & FM, Transmitters, receivers. Standing wave ratio, various types of Antennas, voltage & current distribution along antenna.</p>		35 Lectures
<p>TEXT BOOKS –</p> <ol style="list-style-type: none"> 1. Aircraft Communications and Navigation Systems by MIKE TOOLEY AND DAVID WYATT (Ch – 2 & 3) – BUTTERWORTH-HEINEMANN 		

Course Code	Title	Credits
USARA305	AIRCRAFT INSTRUMENT SYSTEM	3 Credits (70 lectures)
<p>Unit I: Speed module, transmission of Mach number data, transmission of Vertical speed data, True Air speed computation and pressure error correction. Gyroscope & property, limitation, errors, gyroscopic instruments – Vacuum driven gyro horizon, electric gyro horizon, stand by attitude indicator, Erection system - mechanical & electrical, Fast erection system, errors due to acceleration & turning. Turn & bank indicator, turn coordinator. Heading indicating instrument, magnetic properties, terrestrial magnetism, magnetic variation dip, DR compass, errors, directional gyro, Erection system & errors. RR compass: Flux detector, materials, construction, hysteresis loop, detection of earth's magnetic field, heading indication, errors. Aircraft magnetism: components of hard & soft iron magnetism, deviation co-efficient & compass swinging. Synchronous data transmission system, torque-synchro, control synchro, differential synchro & resolver synchro. Measurement of engine speed, tachogenerator, tacho indicator, servo operated tacho-meter, synchro scope. Measurement of temperature, thermocouple principle, thermocouple harness, EGT indicator, cold junction compensator. Measurement of fuel –Capacitance type fuel quantity gauge, volumetric type of system, fuel flow measurement. Manifold pressure gauge, TPI, EPR. Engine vibration monitoring system.</p>		70 Lectures
<p>TEXT BOOKS – 1. Aircraft Instrument by E.H.J PALLET (Ch – 4, 5, 6, 7, 8, 9, 10, 11, 12, 13 & 14) – STERLING BOOK HOUSE</p>		

Course Code	Title	Credits
USARAP301	<ul style="list-style-type: none"> • AIRFRAME AND SYSTEMS: THEORY OF FLIGHT, LANDING GEAR • AIRCRAFT INSTRUMENT SYSTEM 	2 Credits (60 lectures)
Unit I: Familiarization of Fuselage types ; Familiarization of Wing Structure ; Familiarization of Control Surfaces ; Familiarization of different types of Rivets, Bolts, Nuts, Washers ; Single Row Riveting and Double Row Riveting		15 Lectures
Unit II: Familiarization of Main Landing Gears and different types of Shock Strut		15 Lectures
Unit III: Disassembly cleaning inspection and assembly of Gyro Horizon ; Disassembly cleaning inspection and assembly of Turn and bank indicator ; Disassembly cleaning inspection and assembly of Directional Gyro ; Disassembly cleaning inspection and assembly of Direct Reading Compass ; Disassembly cleaning inspection and assembly of R.P.M Indicator ; Measurement of engine speed with the help of tachometer principle mock-up ; Measurement of Cylinder head temperature with the help of thermocouple principle mock-up.		30 Lectures

Course Code	Title	Credits
USARAP302	<ul style="list-style-type: none"> • DIGITAL ELECTRONICS • AIRCRAFT RADIO COMMUNICATION • AIRCRAFT ELECTRICAL SYSTEM 	3 Credits (90 lectures)
Unit I: To study the characteristics of operation of TTL inverters; Study operation and characteristics of TTL NAND gate; Study operation and characteristics of TTL NOR gate; Construct a exclusive OR gate and study its operation; Study the BJT switching circuit (direct coupled); Construct a clock oscillator and study its operation ; Construct a R-S flip flop & study its operation.		25 Lectures
Unit II: Study of semi conductor diode characteristics ; Study of diode as rectifier circuit in power supply ; Study of Zener diode characteristics ; Study of BJT characteristics ; Study of JFET characteristics ; Study of BJT common emitter circuit ; Study of Common Collector and common base circuit ; Study of capacitor coupled BJT amplifier.		13 Lectures
Unit III: Study of AM modulation and demodulation ; Study the construction and operation of superhet receiver ; Study of sinusoidal oscillator in transmitter ; Familiarization of different types of antennas used in aircraft.		12 Lectures
Unit IV: Identification and purpose of parts of a DC Generator ; Identification of a Series Shunt and Compound Wound Generator ; Dismantling and assembling and other common maintenance practices on a DC Generator – checking of antenna with growler, undercutting of Commutator, checking of carbon brushes ; Identification of different parts of a Carbon pile Voltage Regulator ; Identification of different parts of RC Relay and Differential RC Relay ; Identification of Starter Generator and Normal Generator ; Identification of different parts of Generator Control Unit (GCU)		20 Lectures
Unit V: Identification of different parts of a DC Generator and purpose of each by dismantling of a DC Motor ; Practical on reversing the direction of rotation of a DC Motor ; Practical on different type of DC Starters ; Dismantling and identification of different parts of a DC Starter Motor ; Maintenance practice on DC Motor – changing of brushes, undercutting of Commutator segments, etc.		20 Lectures

SCHEME OF EXAMINATION

Course Code	Title of the Course	Theory		Practical		Total	Duration	
		Written	Internal	Sem End	Internal		Written	Sem End
USARA 301	Aircraft Structure and Systems: Theory of Flight, Landing gear.	60	40	--	--	100	2 Hrs.	--
USARA 302	Aircraft Electrical System	60	40	--	--	100	2 Hrs.	--
USARA 303	Digital Electronics	60	40	--	--	100	2 Hrs.	--
USARA 304	Aircraft Radio Communication	60	40	--	--	100	2 Hrs.	--
USARA 305	Aircraft Instrument System	60	40	--	--	100	2 Hrs.	--
USARA P301	Aircraft Structure and Systems: Theory of Flight, Landing gear.	--	--	60	40	100	--	2 Hrs.
	Aircraft Instrument System							
USARA P302	Aircraft Electrical System	--	--	60	40	100	--	2 Hrs.
	Digital Electronics							
	Aircraft Radio Communication							
Total						700		

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SEMESTER IV

Course Code	UNIT	TOPICS	Credits	L / Week
USARA401	I	THEORY OF FLIGHT	3	1
	II	OXYGEN SYSTEM		1
	III	FIRE PROTECTION		1
USARA402	I	AIRCRAFT ELECTRICITY & ELECTRONICS	3	2
	II			2
USARA403	I	DIGITAL ELECTRONICS	3	4
USARA404	I	AIRCRAFT RADIO COMMUNICATION	3	4
USARA405	I	AIRCRAFT INSTRUMENT SYSTEM	3	4
USARAP401	THEORY OF FLIGHT, OXYGEN SYSTEM, FIRE PROTECTION		2	2
	AIRCRAFT INSTRUMENT SYSTEM			2
USARAP402	AIRCRAFT ELECTRICITY & ELECTRONICS		3	2
	DIGITAL ELECTRONICS			2
	AIRCRAFT RADIO COMMUNICATION			2

SEMESTER IV

Course Code	Title	Credits
USARA401	THEORY OF FLIGHT, OXYGEN SYSTEM, FIRE PROTECTION SYSTEM	3 Credits (45 lectures)
Unit I : Theory of Flight – Gliding & landing: Gliding angle, real & apparent effect of weight. Maneuvers: Acceleration, Pulling out of a dive, loads on turns, spin, side slip, maneuverability, stability & control, Test flight ,take off, climb, steep turn, maximum & minimum speed for level flight, Dutch Roll, Interface of Auto Pilot, components with flight controls.		15 Lectures
Unit II : Oxygen System – Oxygen system: Purpose of the system; Safety portable & fixed Oxygen systems; low pressure and high pressure oxygen system & components; Installation and replacement of Oxygen lines. General familiarization with provision of emergency equipment on modern aircraft such as Emergency exits; Emergency Lights; Megaphone; Signaling Flares; FDR & CVR; Fire Extinguishers.		15 Lectures
Unit III : Fire Protection – Fire extinction Principles, fire extinguisher mediums & their proper use, Fire warning devices, Thermal switches, Thermocouple system, continuous loop fire warning systems, spot detection, smoke detection, fire zones, Routine maintenance, inspection.		15 Lectures
TEXT BOOKS – 1. Mechanics of Flight (11 th Edition) by A.C.KARMODE (Ch – 6, 8) – PEARSON EDUCATION Ltd. 2. 1. Airframe and Power plant Mechanics Airframe Handbook (AC65 – 15A) (Ch – 14 & 10) – SHROFF PUBLISHER AND DISTRIBUTERS Pvt. Ltd.		

Course Code	Title	Credits
USARA402	AIRCRAFT ELECTRICITY & ELECTRONICS	3 Credits (70 lectures)
Unit I : Alternators, Principle of AC generation, construction, Single & Poly phase alternators, DC Alternators, Transistorized voltage regulators, Brushless alternators, Permanent magnet brushless Alternators , Principle of operation of Constant Speed Drive Unit, Integrated Drive Generators, Synchronizing of Alternators Static and Rotary Inverters ,A C generator system protection, GCU & BPCU.		35 Lectures
Unit II : Production of rotating magnetic field in the stator of an AC motor, AC Motor construction, 3-phase & single phase motors, Synchronous motors, Slip in an induction motor, capacitor action of over-excited synchronous motor, split phase capacitor start motors, shaded pole motors, universal motors, hysteresis motors, transformers, transformer on load, regulation of transformers, equivalent circuit of transformers, three phase transformers, auto transformers, transformer rectifier units, three phase transformer rectifier units, use of electrical diagrams, Maintenance of generators, motors & transformers.		35 Lectures
TEXT BOOKS – 1. Aircraft Electricity and Electronics by EISMIN (Ch – 11) 2. Examples in Electrical Calculation by ADMIRALTY (BR158) (Ch – 23, 24, 25, 26) 3. Electrical Technology by B.L.THERAJA (Ch – 27, 28, 29, 30, 31, 32, 33)		

Course Code	Title	Credits
USARA403	DIGITAL ELECTRONICS	3 Credits (70 lectures)
<p>Unit I: Processing Circuits:-Demultiplexer use as decoder, 1to 16 decoder, BCD to decimal decoder, seven segment decoder, Encoders. Exclusive OR gate & its use as parity generator & checker. Memories ROM, PROM, EPROM, EEPROMS, Programmable Array logic devices. Registers: - Introduction & types. Registers , serial in-serial out, serial in- parallel out, parallel in- serial out, parallel in-parallel out types. Basic functioning of types, applications of shift registers. Counters:- Functioning of counters, types o f counters synchronous and asynchronous counters. Working principles, UP, DN, UPDN counters, Decoding gates, Decade Counters, Changing of counter modulus, Preset table counters, and counter applications. D/A & A/D conversion: - Variable resistor networks, binary ladders networks, D/A converter, D/A accuracy & Resolution, A to D conversion methods–simultaneous conversion, counter method, continuous A to D conversion, Dual Slope AD conversion accuracy & Resolution. Memory: - Basic terms, types of memory–Magnetic & optical, semi conductor. Memory addressing, volatile, non volatile static & dynamic RAMS. Primary & secondary storage devices used in digital systems.</p>		70 Lectures
<p>TEXT BOOKS – 1. Digital Principles and Applications by DONALD P. LEACH, ALBERTPAUL MALVINO, GOUTAM SAHA (Ch –4,9,10,12, &13) – TATA MCGRAW HILL COMPANIES</p>		

Course Code	Title	Credits
USARA404	AIRCRAFT RADIO COMMUNICATION	3 Credits (70 lectures)
<p>Unit I: Radio Communication; Basic Principles; Receivers & Transmitters; Antenna; Microphone; Power supply; Interphone; HF and VHF systems; Installation of Units on aircraft; Inspection and checks on aircraft. Electronic Navigation equipment; Automatic Direction finding system; Principles; equipment & Maintenance; visual omni range and Instruments Landing systems; operating principles; components and functions operation of DME, Doppler,ELT.</p>		70 Lectures
<p>TEXT BOOKS – 1. Aircraft Radio Systems JAMES POWELL (Ch–1, 2, 3, 4, 5, 7, 10)–STERLING BOOKHOUSE</p>		

Course Code	Title	Credits
USARA405	AIRCRAFT INSTRUMENT SYSTEM	3 Credits (70 lectures)
<p>Unit I: Principles of flight, Servomechanism & automatic control fundamentals, Sensing of attitude changes, Command signal detection, Command Signal Processing, Outer Loop Control, Conversion of command signal to Powered Control, Flight director & integrated flight control system, Automatic landing ; Flux gate system ; Inertial Navigation systems</p>		70 Lectures
<p>TEXT BOOKS – 1. Automatic Flight Controls (4th Edition) by E.H.J PALLET (Ch – 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 & 11) – BLACKWELL PUBLISHING</p>		

Course Code	Title	Credits
USARAP401	<ul style="list-style-type: none"> • THEORY OF FLIGHT, OXYGEN SYSTEM, FIRE PROTECTION SYSTEM • AIRCRAFT INSTRUMENT SYSTEM 	2 Credits (60 lectures)
Unit I: Theory of Flight – Make a flying model of a glider and means to run it on ground and lift it up ; Make remote controls on the model to change the gliding angle, speed and altitude.		15 Lectures
Unit II:Oxygen System –Draw PIE-CHART to indicate the percentage of oxygen and other gases in the atmosphere; Show in an aircraft model the different sources of oxygen available on aircraft; Procedure to charge the oxygen bottle with the use of high pressure regulator; Locate and find the function of Emergency Lights, Megaphone, Signaling Flares, FDR & CVR, Fire Extinguishers.		15 Lectures
Unit III: Fire Protection – Show type and location of fire extinguishers on aircraft ; Make models of different types of fire detecting devices an aircraft - Thermal switches, Thermocouple, Smoke detectors, Continuous lop system.		15 Lectures
UNIT IV: Aircraft Instrument system - Practice of connecting primary control surfaces to control column through the linkages and their operation; Operation of primary control surfaces as per Autopilot system.		15 Lectures

Course Code	Title	Credits
USARAP402	<ul style="list-style-type: none"> • AIRCRAFT ELECTRICITY & ELCTRONICS • DIGITAL ELECTRONICS • AIRCRAFT RADIO COMMUNICATION 	3 Credits (90 lectures)
Unit I: Practical in single phase and poly phase ; Practical on dismantling of DC alternators and finding the location of the diodes in a DC alternator ; Practical on how a transistorized voltage regulator works ; Practical an identifying the parts of a transistorized voltage regulator ; Practical an identifying the parts and location of a rotary / Static inverters ; Practical on various types of protection circuits of AC generator system such as BPCU of GCU.		30 Lectures
Unit II: Practical on construction of A.C. Generator ; Practical explanation of principle on which the slip rings functions ; Practical on dismantling of an A.C. motor ; Identification of parts of A.C. Motor and re assembling the same ; Practical on the purpose of a capacitor in a single phase Induction motor ; Practical on reversing the direction of rotation ; Practical on shaded pole motors ; Practical on the construction of a transformer both single phase and three phase ; Checking the transformer for serviceability such as Input, Output and insulation etc ; Maintenance of A.C. Generators such as checking insulation, output voltage,bearing changing etc.		35 Lectures
Unit III: Study the operation of shift register ; Study operation of BCD to decimal decoder ; Operation of a BCD 7 segment decoder driver and LED display ; Operation and characteristics a counter ; Study of microprocessor operation.		10 Lectures
Unit IV: Study of operation of Microphone ; Study of full wave & Bridge rectifier power supply operation ; Familiarization of communication system VHF & its components & test ; Familiarization of HF system and its components & tests ; Familiarization of automatic direction finding system component & test ; Familiarization of ILS components & tests.		15 Lectures

SCHEME OF EXAMINATION

Course Code	Title of the Course	Theory		Practical		Total	Duration	
		Written	Internal	Sem End	Internal		Written	Sem End
USARA 401	Theory of Flight, Oxygen System, Fire Protection System.	60	40	--	--	100	2 Hrs.	--
USARA 402	Aircraft Electrical System	60	40	--	--	100	2 Hrs.	--
USARA 403	Digital Electronics	60	40	--	--	100	2 Hrs.	--
USARA 404	Aircraft Radio Communication	60	40	--	--	100	2 Hrs.	--
USARA 405	Aircraft Instrument System	60	40	--	--	100	2 Hrs.	--
USARA P401	Theory of Flight	--	--	60	40	100	--	2 Hrs.
	Oxygen System							
	Fire Protection							
USARA P402	Aircraft Electrical System	--	--	60	40	100	--	2 Hrs.
	Digital Electronics							
	Aircraft Radio Communication							
Total						700		