

H.J. SRI GURUDEVAH

# S. J. C. Institute of Technology, Chickballapur

CALENDAR OF EVENTS FOR THE ACADEMIC YEAR 2019-2020 (ODD SEMESTER) FOR B.E, MBA & M.Tech



Accredited by NAAC & Certified by ISO 9001-2015

| Week No. | Month      | Week Days |     |     |     |     |     |     | Number of Working Days                 | EVENTS  |
|----------|------------|-----------|-----|-----|-----|-----|-----|-----|--|---|
|          |            | Mon       | Tue | Wed | Thu | Fri | Sat | Sun |  |   |
| 1.       | JULY       | 22        | 23  | 24  | 25  | 26  | 27  | 28  | 6                                      | 26 <sup>th</sup> July - Commencement of 3 <sup>rd</sup> Semester MTech  |
| 2.       | JULY & AUG | 29        | 30  | 31  | 1   | 2   | 3   | 4   | 6                                      | 29 <sup>th</sup> July - Commencement of 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> Semester BE Classes, 31 <sup>st</sup> July - HODs meeting<br>1 <sup>st</sup> August - Commencement of 1 <sup>st</sup> Semester BE Classes, 3 <sup>rd</sup> August - 7 <sup>th</sup> Semester Project (Phase - 1) First Review |
| 3.       | AUG        | 5         | 6   | 7   | 8   | 9   | 10  | 11  | 6                                      | 7 <sup>th</sup> August - Proctor Meeting, 8 <sup>th</sup> August - Commencement of 3 <sup>rd</sup> Semester MBA Classes<br>10 <sup>th</sup> August - 7 <sup>th</sup> Semester Project (Phase - 1) First Review  |
| 4.       | AUG        | 12        | 13  | 14  | 15  | 16  | 17  | 18  | 4                                      | 12 <sup>th</sup> August - Bakrid, 15 <sup>th</sup> August - Independence Day, 13 <sup>th</sup> August - Announcement of Shortage of Attendance  |
| 5.       | AUG        | 19        | 20  | 21  | 22  | 23  | 24  | 25  | 6                                      | 24 <sup>th</sup> August - Sports & NSS Activity   |
| 6.       | AUG & SEP  | 26        | 27  | 28  | 29  | 30  | 31  | 1   | 28 <sup>th</sup> August - HODs Meeting |   |
| 7.       | SEP        | 3         | 4   | 5   | 6   | 7   | 8   | 9   | 5                                      | 28 <sup>th</sup> September - Vinayaka Chautharthi, 1 <sup>st</sup> September - Announcement of Attendance<br>3 <sup>rd</sup> to 7 <sup>th</sup> September - Tutorial-1, 7 <sup>th</sup> October - 7 <sup>th</sup> Semester Project (Phase - 1) Second Review  |
| 8.       | SEP        | 9         | 10  | 11  | 12  | 13  | 14  | 15  | 5                                      | 10 <sup>th</sup> September - Mohanani Fast Day, 12 <sup>th</sup> , 13 <sup>th</sup> & 14 <sup>th</sup> September - Test 1   |
| 9.       | SEP        | 16        | 17  | 18  | 19  | 20  | 21  | 22  | 6                                      | 19 <sup>th</sup> September - Submission of Test - 1 IA Marks, 20 <sup>th</sup> September - Test 1 Progress Report Dispatch  |
| 10.      | SEP        | 23        | 24  | 25  | 26  | 27  | 28  | 29  | 5                                      | 21 <sup>st</sup> September - 7 <sup>th</sup> Semester Project (Phase - 1) Second Review, 21 <sup>st</sup> September - Sports & NSS Activity   |
| 11.      | SEP & OCT  | 30        | 1   | 2   | 3   | 4   | 5   | 6   | 5                                      | 25 <sup>th</sup> September - Class Teachers Meeting & Proctor Meeting, 28 <sup>th</sup> September - Mahalaya Amavasya   |
| 12.      | OCT        | 7         | 8   | 9   | 10  | 11  | 12  | 13  | 4                                      | 1 <sup>st</sup> October - Announcement of Attendance, 2 <sup>nd</sup> October - Mahatma Gandhi Jayanthi<br>7 <sup>th</sup> October - Ayudha Poopa, 8 <sup>th</sup> October - Vijaydashami, 9 <sup>th</sup> September - HODs Meeting, 9 <sup>th</sup> to 12 <sup>th</sup> October - Tutorial - 2                           |
| 13.      | OCT        | 14        | 15  | 16  | 17  | 18  | 19  | 20  | 6                                      | 13 <sup>th</sup> October - Maharashtra Valmiki Jayanthi<br>17 <sup>th</sup> , 18 <sup>th</sup> & 19 <sup>th</sup> October - Test 2, 18 <sup>th</sup> Internal Audit   |
| 14.      | OCT        | 21        | 22  | 23  | 24  | 25  | 26  | 27  | 6                                      | 24 <sup>th</sup> October - Submission of IA Marks, 25 <sup>th</sup> October - Test 2 Progress Report Dispatch<br>26 <sup>th</sup> October - 7 <sup>th</sup> Semester Project Phase - 1 Third Review, 26 <sup>th</sup> October - Sports & NSS Activity   |
| 15.      | OCT & NOV  | 28        | 29  | 30  | 31  | 1   | 2   | 3   | 4                                      | 29 <sup>th</sup> October - Balipadyana & Deepavali, 30 <sup>th</sup> October - HODs, Class Teachers Meeting and Proctor Meeting<br>1 <sup>st</sup> November - Kannada Bahubharya, 2 <sup>nd</sup> November - 7 <sup>th</sup> Semester Project Phase - 1 Third Review  |
| 16.      | NOV        | 4         | 5   | 6   | 7   | 8   | 9   | 10  | 5                                      | 4 <sup>th</sup> November - Announcement of Attendance, 10 <sup>th</sup> November - Ed Milad   |
| 17.      | NOV        | 11        | 12  | 13  | 14  | 15  | 16  | 17  | 5                                      | 11 <sup>th</sup> to 16 <sup>th</sup> - Tutorial 3, 17 <sup>th</sup> November - HODs Meeting, 15 <sup>th</sup> November - Kanaka Dasa Jayanthi   |
| 18.      | NOV        | 18        | 19  | 20  | 21  | 22  | 23  | 24  | 6                                      | 21 <sup>st</sup> , 22 <sup>nd</sup> & 23 <sup>rd</sup> November - 27 <sup>th</sup> November - Submission of IA Marks  |
| 19.      | NOV        | 25        | 26  | 27  | 28  | 29  | 30  | 1   | 6                                      | 29 <sup>th</sup> - Last Working Day for 1 <sup>st</sup> Semester BE Classes, 30 <sup>th</sup> November - Last Working Day for 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> Semester BE classes   |
| 20.      | DEC        | 2         | 3   | 4   | 5   | 6   | 7   | 8   | 6                                      | 3 <sup>rd</sup> December - Commencement of Practical Examinations for 1 <sup>st</sup> , 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> Semester BE Classes   |
| 21.      | DEC        | 9         | 10  | 11  | 12  | 13  | 14  | 15  | 6                                      | 5 <sup>th</sup> December - Last Working Day for 3 <sup>rd</sup> Semester MBA Classes  |
| 22.      | DEC        | 16        | 17  | 18  | 19  | 20  | 21  | 22  | 6                                      | 9 <sup>th</sup> December - Commencement Theory Examination for 3 <sup>rd</sup> Semester MBA Students  |
| 23.      | DEC        | 23        | 24  | 25  | 26  | 27  | 28  | 29  | 5                                      | 16 <sup>th</sup> December - Commencement Theory Examination for 1 <sup>st</sup> , 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> Semester BE Students<br>27 <sup>th</sup> December - Commencement Theory Examination for 3 <sup>rd</sup> Semester MTech Students   |

27<sup>th</sup> January 2020 - Commencement of 2<sup>nd</sup> Semester BE, 4<sup>th</sup> Semester MBA & 4<sup>th</sup> Semester MTech classes // 10<sup>th</sup> February 2020 Commencement of 4<sup>th</sup>, 6<sup>th</sup> & 8<sup>th</sup> Semester BE classes  
 Note: VII Semester B. E Students shall have to undergo Internship for a period of four Weeks  
 Note: I Semester B. E Students shall compulsorily undergo Induction Program for a period of 3 Weeks (two phases) as per the schedule given by VTU. First phase 11 days in first semester and second phase 10 days in second semester

**VISION**

SJGIT is Committed to Quality Education, Training and Research

- ❖ Augmenting the supply of Competent Engineers and Managers
- ❖ Building Engineers and managers with Value, Vision and Versatility
- ❖ Developing and Disseminating New Knowledge and Insights

**MISSION**

Dr. G. V Gnanendra Reddy  
Academic In-charge

Dr. K.M. Ravi Kumar  
Principal

HOLIDAYS: Red

| Week No. | Month    | Week Days |     |     |     |     |     |     | Events   |
|----------|----------|-----------|-----|-----|-----|-----|-----|-----|--|
|          |          | Mon       | Tue | Wed | Thu | Fri | Sat | Sun |  |
| 1        | Jul/Aug  | 29        | 30  | 31  | 1   | 2   | 3   | 4   | 29 <sup>th</sup> July Commencement of III, V, VII Sem B E Classes  |
| 2        | Aug      | 5         | 6   | 7   | 8   | 9   | 10  | 11  | 7 <sup>th</sup> Sept - 7th Sem Project Phase-I First Review  |
| 3        | Aug      | 12        | 13  | 14  | 15  | 16  | 17  | 18  | 12 <sup>th</sup> Aug Bakrid, 13 <sup>th</sup> Aug Announcement of Shortage of Attendance, 15 <sup>th</sup> Aug Independence Day : 7 Aug - 7th Sem Project Phase-I First Review   |
| 4        | Aug      | 19        | 20  | 21  | 22  | 23  | 24  | 25  | 21 <sup>st</sup> Aug Dept Meeting  |
| 5        | Aug/Sept | 26        | 27  | 28  | 29  | 30  | 31  | 1   | 28 <sup>th</sup> Aug Dept Meeting, 30 <sup>th</sup> Aug Submission of Attendance Register for attendances,   |
| 6        | Sept     | 2         | 3   | 4   | 5   | 6   | 7   | 8   | 2 <sup>nd</sup> Sept. Vinayaka Chaturthi, 3 <sup>rd</sup> Sept Attendance Registers submission for HOD's Signature, 3 <sup>rd</sup> Sept Announcement of Attendance, 7 <sup>th</sup> Sept Tutorials-I, 7 <sup>th</sup> Sept - 7th Sem Project Phase-I Second Review  |
| 7        | Sept     | 9         | 10  | 11  | 12  | 13  | 14  | 15  | 10 <sup>th</sup> Sept Mohararam Last Day, 12 <sup>th</sup> & 14 <sup>th</sup> Sept Test-I  |
| 8        | Sept     | 16        | 17  | 18  | 19  | 20  | 21  | 22  | 19 <sup>th</sup> Sept Submission of Test IIA Marks, 20 <sup>th</sup> September - Test I Progress Report Dispatch, 16 <sup>th</sup> Sept Guest Lecture  |
| 9        | Sept     | 23        | 24  | 25  | 26  | 27  | 28  | 29  | 21 <sup>st</sup> Sept - 7th Sem Project Phase I Second Review, 23 <sup>rd</sup> to 20 <sup>th</sup> Sept - 7th Sem Project Phase I Internal Visit  |
| 10       | Sept/Oct | 30        | 1   | 2   | 3   | 4   | 5   | 6   | 28 <sup>th</sup> Sept Mahatma Amavasya, 25 <sup>th</sup> Sept Last date for Proctor Book Entry, 25 <sup>th</sup> Sept Class Teachers Meeting, 25 <sup>th</sup> Sept Dept Meeting, 29 <sup>th</sup> Sept Submission of Attendance Register for attendances,   |
| 11       | Oct      | 7         | 8   | 9   | 10  | 11  | 12  | 13  | 1 <sup>st</sup> Oct Attendance Registers submission for HOD's Signature, 1 <sup>st</sup> Oct Announcement of Attendance, 2 <sup>nd</sup> Oct Mahatma Gandhi Jayanthi   |
| 12       | Oct      | 14        | 15  | 16  | 17  | 18  | 19  | 20  | 7 <sup>th</sup> Oct Ayudha Pooja, 8 <sup>th</sup> Oct Vijayadashami, 9 <sup>th</sup> to 12 <sup>th</sup> Oct, 3 <sup>rd</sup> to 6 <sup>th</sup> Tutorials-II, 13 <sup>th</sup> Oct Maharshi Valmiki Jayanthi  |
| 13       | Oct      | 21        | 22  | 23  | 24  | 25  | 26  | 27  | 17 <sup>th</sup> , 18 <sup>th</sup> & 19 <sup>th</sup> Oct - Test-II / ISO Internal Audit  |
| 14       | Oct/Nov  | 28        | 29  | 30  | 31  | 1   | 2   | 3   | 24 <sup>th</sup> Submission of IA Marks, 23 <sup>rd</sup> Oct Last date for Proctor Book Entry, 25 <sup>th</sup> Oct Test-II Progress Report Dispatch, 23 <sup>rd</sup> October Dept Meeting, 25 <sup>th</sup> Oct 7th Sem Project Phase-I Third Review  |
| 15       | Nov      | 4         | 5   | 6   | 7   | 8   | 9   | 10  | 29 <sup>th</sup> October Balipadyami & Deepavali, 1 <sup>st</sup> Nov Kannada Rajyotsava, 2 <sup>nd</sup> Nov Attendance Registers submission for HOD's Signature, 30 <sup>th</sup> Oct Submission of Attendance Register for attendances, 30 <sup>th</sup> Oct HOD's & Class Teachers Meeting.  |
| 16       | Nov      | 11        | 12  | 13  | 14  | 15  | 16  | 17  | 4 <sup>th</sup> Nov Announcement of Attendance, 10 <sup>th</sup> Nov Ed-Milad  |
| 17       | Nov      | 18        | 19  | 20  | 21  | 22  | 23  | 24  | 11 <sup>th</sup> to 16 <sup>th</sup> Nov Tutorials III, 15 <sup>th</sup> Nov Kanakadasa Jayanthi   |
| 18       | Nov/Dec  | 25        | 26  | 27  | 28  | 29  | 30  | 1   | 21 <sup>st</sup> 22 <sup>nd</sup> & 23 <sup>rd</sup> Nov Test-III  |
| 19       | Dec      | 2         | 3   | 4   | 5   | 6   | 7   | 8   | 27 <sup>th</sup> Nov Submission of IA Marks, 27 <sup>th</sup> Nov Progress Report Dispatch, 27 <sup>th</sup> Nov Dept Meeting, 30 <sup>th</sup> Nov Final Attendance submission, 29 <sup>th</sup> Nov Last date for Proctor Book Entry, 30 <sup>th</sup> Nov Last Working Day of 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> Sem BE classes, 30 <sup>th</sup> Nov Submission of Attendance Register for attendances, |
| 20       | Dec      | 9         | 10  | 11  | 12  | 13  | 14  | 15  | 3 <sup>rd</sup> Dec Commencement of Practical Exams for 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> BE,  |
| 21       | Dec      | 16        | 17  | 18  | 19  | 20  | 21  | 22  | Practical Exams for 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> BE,  |
| 22       | Dec      | 23        | 24  | 25  | 26  | 27  | 28  | 29  | 16 <sup>th</sup> Dec Commencement of Theory Exams for 3 <sup>rd</sup> , 5 <sup>th</sup> & 7 <sup>th</sup> BE, 25 <sup>th</sup> Dec Christmas   |

**NOTE: Every Monday Proctor Counseling will be held in 4<sup>th</sup> hour class**

|              |                 |              |                        |
|--------------|-----------------|--------------|------------------------|
| Prepared by: | Prof. Prajesh N | Approved by: | Prof. Saptaraj (Retd.) |
| Date & Sign: | 10/2/19         | Date & Sign: | (S. Rajan)             |

## Academic Calendar of VTU, Belagavi for ODD Semester of 2019-2020 (Jul 2019 – Jan 2020)

|   | I Sem B. E. /<br>B. Tech. / B. Arch.<br>(Tentative) | III, V & VII Sem B. E. / B. Tech.<br>III, V, VII & IX Sem B. Arch. | III & V Sem MCA                | III Sem MBA                    | III Sem M. Tech.               | III Sem M. Arch.               |
|---|---|--|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Commencement of<br>ODD Semester               | 01.08.2019  | 29.07.2019   | 29.07.2019                     | 08.08.2019                     | 26.08.2019                     | 08.09.2019                     |
| Last Working day<br>of ODD Semester           | 29.11.2019  | 30.11.2019   | 30.11.2019                     | 05.12.2019                     | 23.12.2019                     | 06.01.2020                     |
| Practical<br>Examinations                     | 03.12.2019<br>To<br>13.12.2019                      | 03.12.2019<br>To<br>13.12.2019                                     | 03.12.2019<br>To<br>07.12.2019 | -                              | -                              | -                              |
| Theory<br>Examinations                        | 16.12.2019<br>To<br>04.01.2020                      | 16.12.2019<br>To<br>07.02.2020                                     | 09.12.2019<br>To<br>28.12.2019 | 09.12.2019<br>To<br>04.01.2020 | 27.12.2019<br>To<br>10.01.2020 | 08.01.2020<br>To<br>22.01.2020 |
| Internship Viva-Voce                          | -   | -  | -                              | -                              | 12.01.2020<br>To<br>19.01.2020 | -                              |
| Professional training<br>/ Organization study | -   | -  | -                              | -                              | -                              | -                              |
| Commencement of<br>EVEN Semester              | 27.01.2020  | 10.02.2020   | 27.01.2020                     | 27.01.2020                     | 27.01.2020                     | 01.02.2020                     |

### NOTE

- VII Semester B. E. / B. Tech students shall have to undergo Internship for a period of four Weeks.
  - I Semester B. E. / B. Tech / B. Arch Students shall compulsorily undergo Induction Program for a period of 3 Weeks (two phases) as per the schedule given by VTU. First phase 11 days in first semester and second phase 10 days in second semester.
1. College Time Table shall be arranged for five and a half week days and planned to accommodate EDUSAT transmission slots, the schedule of which will be notified separately.
  2. The faculty/staff shall be available to undertake any work assigned by the university.
  3. If any of the above date is declared to be a holiday then the corresponding event will come into effect on the next working day.
  4. Notification regarding Calendar of Events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

|| JAI SRI GURUDEV ||

**S.J.C.INSTITUTE OF TECHNOLOGY, CHICKBALLAPUR**

**TIME TABLE FOR THE YEAR: 2019-20 (ODD SEMESTER)**

For the period: July 2019 TO November 2019

Version:2

Department: Aeronautical Engineering

Staff Name: Dr. Bino Prince Raja D

Semester: III & V B.E.

Room No: LH 201 & LH 202

| DAYS/TIME | 9.00am To 10.00am | 10.00am To 10.50am | 10.50am To 11.00am                    | 11.00am To 11.50am | 11.50am To 12.40pm | 12.40pm To 1.30pm | 1.30pm To 2.20pm                                   | 2.20pm To 3.10pm | 3.10pm To 4.00pm | 4.00pm To 4.10pm | 4.10pm To 5.00pm |
|-----------|-------------------|--------------------|---------------------------------------|--------------------|--------------------|-------------------|--|------------------|------------------|------------------|------------------|
| Monday    | ICM (17AE52)      |                    | Machine Shop – Batch 2 + Prof Vinay P |                    |                    |                   | MOM (18AE34)                                       | MOM (18AE34)     |                  |                  |                  |
| Tuesday   |                   |                    | MOM (18AE34)                          |                    | LUNCH BREAK        |                   |  |                  |                  |                  |                  |
| Wednesday |                   |                    |                                       |                    |                    |                   | Flight Simulation Lab – Batch 1 + Prof. Praveen .N |                  |                  | BREAK            |                  |
| Thursday  | MOM (18AE34)      |                    |                                       | ICM (17AE52)       |                    |                   | EC & FM Lab- Batch 2 + Prof. Vigneswaran CM        |                  | ICM (17AE52)     |                  | MOM (18AE34)     |
| Friday    |                   |                    |                                       | ICM (17AE52)       |                    |                   |  |                  | MOM (18AE34)     |                  | ICM (17AE52)     |
| Saturday  |                   | MOM (18AE34)       |                                       | ICM (17AE52)       |                    |                   |  |                  |                  |                  |                  |

|               |                  |               |                            |
|---------------|------------------|---------------|----------------------------|
| Prepared by:  | Prof. Praveen .N | Approved by:  | Gp. Capt. V. Rajan (Retd.) |
| Date & Sign : | 12/11/19         | Date & Sign : | 12/11/19                   |

FROM  
Department of Aeronautical Engineering  
S.J.C. Institute of Technology  
CHICKBALLAPUR-562191

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SCHEME OF TEACHING AND EXAMINATION 2017-2018**

**Reference Books:**

1. Management Fundamentals- Concepts, Application, Skill Development-Robers Lusier-Thomson
2. Entrepreneurship Development - S.S. Khanka- S. Chand & Co.
3. Management-Stephen Robbins-Pearson Education/PHI-17<sup>th</sup> Edition,2003.

**INTRODUCTION TO COMPOSITE MATERIALS**

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

|                               |        |            |    |
|-------------------------------|--------|------------|----|
| Subject Code                  | 17AE52 | IA Marks   | 40 |
| Number of Lecture Hours/Week  | 04     | Exam Hours | 03 |
| Total Number of Lecture Hours | 50     | Exam Marks | 60 |

**CREDITS – 04**

**Course Objectives:**

This course will enable students to

1. Understand the advantages of composite materials compared to conventional materials
2. Evaluate the properties of polymer matrix composites with fiber reinforcements
3. Explain the manufacturing process and applications of composite materials

| Modules  | Teaching Hours  | Revised Bloom's Taxonomy (RBT) Level |
|--|-----------------|--------------------------------------|
| <p><b>Module -1</b><br/> <b>Introduction to Composite Materials</b><br/>                     Definition, classification of composite materials, classification of reinforcement - particulate, short fiber, whiskers, long fibers composites. matrix materials – metals, ceramics, polymers (including thermoplastics and thermosets), Carbon-Carbon Composites<br/> <b>Metal Matrix Composites:</b><br/>                     MMC with particulate and short fiber reinforcement, liquid and solid state processing of MMC – stir casting, squeeze casting. Properties of MMCs, Applications of Al, Mg, Ti based MMC</p> | <b>8 Hours</b>  | <b>L1, L2, L3</b>                    |
| <p><b>Module -2</b><br/> <b>Processing of Polymer Matrix Composites:</b> Thermoset Polymers, Hand layup Process, Vacuum Bagging Process, Post Curing Process, Filament winding, Pultrusion, Pulforming, Autoclave Process<br/> <b>Processing of Polymer Matrix Composites:</b> Thermoplastic Polymers, Extrusion process, Injection Moulding Process, Thermo-forming process. <b>Post Processing of Composites</b> – Adhesive bonding, drilling, cutting processes.</p>  | <b>10 Hours</b> | <b>L1, L2,L3</b>                     |
| <p><b>Module -3</b><br/> <b>Micro-Mechanical Behavior of a Lamina</b><br/>                     Determination of elastic constants-Rule of mixtures, transformation of coordinates, micro-mechanics based analysis and experimental determination of material constants.<br/> <b>Macro-Mechanical Behavior of a Lamina:</b><br/>                     Global and local axis for angle lamina, determination of global and local stresses and moduli, for 2D-UD lamina with different fiber orientation</p>   | <b>12 Hours</b> | <b>L2, L3, L4</b>                    |

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SCHEME OF TEACHING AND EXAMINATION 2017-2018**

|  |                 |                 |
|--|-----------------|-----------------|
| and different fiber materials glass, carbon and aramid fiber reinforcement.  |                 |                 |
| <b>Module -4</b><br><b>Failure Theory</b> – Tsai-Hill, Tsai-Wu, Max Stress and Max Strain<br>Classical plate theory- Stress and strain variation in a laminate-<br>Resultant forces and moments- A B & D matrices- Strength analysis of a laminate.  | <b>10 Hours</b> | <b>L3,L4,L5</b> |
| <b>Module -5</b><br><b>Inspection &amp; Quality Control:</b> Destructive & Non-Destructive Testing, Tensile, Compression, Flexural, Shear, Hardness; ultrasonic testing – A-B-C scan<br><b>Applications of Composites Materials</b><br>Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.   | <b>10 Hours</b> | <b>L2, L3</b>   |
| <b>Course Outcomes:</b><br><br>After studying this course, students will be able to:<br><ol style="list-style-type: none"> <li>1. Explain the advantages of using composite materials as an alternative to conventional materials for specific applications</li> <li>2. Describe the advanced fabrication and processing for producing composite parts.</li> <li>3. Evaluate the micro- and macro-mechanical behavior of composite laminates</li> </ol>  |                 |                 |
| <b>Graduate Attributes:</b><br><br><ul style="list-style-type: none"> <li>o Engineering Knowledge.</li> <li>o Problem Analysis.</li> <li>o Design / development of solutions</li> <li>o Modern Tool Usage and Interpretation of data</li> </ul>  |                 |                 |
| <b>Question paper pattern:</b><br><br><ul style="list-style-type: none"> <li>• The question paper will have ten questions.</li> <li>• Each full question consists of 16 marks.</li> <li>• There will be 2 full questions (with a maximum of four sub questions) from each module.</li> <li>• Each full question will have sub questions covering all the topics under a module.</li> <li>• The students will have to answer 5 full questions, selecting one full question from each module.</li> </ul> |                 |                 |
| <b>Text Books:</b><br><ol style="list-style-type: none"> <li>1. <b>K.K Chawla</b>, Composite Materials- Science and Engineering, II edition, Springer Verlag, 1998: ISBN: 0-387-98409-7</li> <li>2. <b>Autar Kaw</b>, Mechanics of Composites, II edition, CRC Press. 2006, ISBN:978-0-8493-1343-1</li> </ol>  |                 |                 |
| <b>Reference Books:</b><br><ol style="list-style-type: none"> <li>1. <b>Mein Schwartz</b>, Composite Materials Handbook, Vol.3, Department of Defense, USA, 2002.</li> <li>2. <b>Ajay Kapadia</b>, Non-Destructive Testing of Composite Materials, National Composites Network, Best Practices Guide, TWI Publications, 2006.</li> <li>3. <b>R M Jones</b>, “ Mechanics of Composite Materials”, 2<sup>nd</sup>Edn, Taylor &amp; Francis, 2015; ISBN:978-1560327127</li> </ol>                         |                 |                 |

  
**(V Rajin) 29/7/19**  
**PROFESSOR & HEAD**  
 Department of Aeronautical Engineering  
 S.J.C. Institute of Technology  
 CHICKBALLAPUR-562101



Name of the staff: **Dr. Bino Prince Raja. D** Semester: **V**  
 Subject: **Introduction to Composite Materials** Sub code: **17AE52**

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

|     |   |
|-----|---|
| CO1 | Understand the concept of composite materials over monolithic materials, as well as some basic knowledge about constituents of composite materials (L3)                                       |
| CO2 | Examine the properties of fiber and matrix materials used in commercial applications. The different fabrication techniques, which is used to investigate the PMC, CMC and MMC composites (L2) |
| CO3 | Ability to analyze problems on micro-mechanical and macro-mechanical behavior of lamina (L3)  |
| CO4 | Predict the failure strength of a laminated composite plate and identify the suitable machining method for a given type of laminate (L3)  |
| CO5 | Analyzing the failure using NDT technique and able to perform different types of characterization such as tensile, flexural, impact and hardness test etc.(L3)                                |
| CO6 | Ability to perform literature review on a selected advanced composite material topic and should be able to give demo in class(L2)   |

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO2 | 3   | -   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO3 | 3   | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO4 | 3   | 2   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO5 | 3   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO6 | 3   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 2    | 2    | 2    |

*(V. Rajan)*  
**PROFESSOR & HEAD** 7/19  
 Department of Aeronautical Engineering  
 S.J.C. Institute of Technology

*Bino Prince Raja*  
 29/07/2019

| <b>CO-PO Justification</b>  |   |
|-----------------------------|---|
| <b>CO</b>                   |   |
| <b>CO1</b>                  | The knowledge of engineering fundamentals and analysis of complex problems are very much essential hence it is mapped to PO1. Composite Materials is the key for the selection of Aircraft Material, also Life long learning is Composites hence it is mapped to PO12 |
| <b>CO2</b>                  | The knowledge of basic and analysis of complex problems is required to understand material properties and fabrication methods, hence it is mapped to PO1 & PO3. also, Lifelong learning is necessary for measurement and Metrology hence it is mapped to PO12         |
| <b>CO3</b>                  | Analyzing problems on micro and macro mechanical behavior of lamina is very much essential for aircraft material design, hence it correlates with PO1, PO2 & PO12   |
| <b>CO4</b>                  | Predict the failure strength of composite laminate is important, hence it is strongly mapped to PO1, PO2, PO3& PO12   |
| <b>CO5</b>                  | Studying about the NDT techniques are quite necessary for composite materials so it is mapped to PO1 & PO12   |
| <b>CO6</b>                  | Students should be able to do literature review on selected composites; hence it is mapped to PO1 & PO12  |
| <b>CO</b>                   |   |
| <b>CO-PSO Justification</b> |   |
| <b>CO1</b>                  | The knowledge of engineering fundamentals and analysis of complex problems are very much essential hence it is mapped PSO1 and PSO2   |
| <b>CO2</b>                  | The knowledge of mathematic and analysis of complex problems is required to understand material properties and fabrication methods, hence it is mapped to PSO1 and PSO2   |
| <b>CO3</b>                  | Analyzing problems on micro and macro mechanical behavior of lamina is very much essential for aircraft material design, hence it correlates with PSO1 and PSO2   |
| <b>CO4</b>                  | Predict the failure strength of material of composite laminate is important, hence it is strongly mapped to PSO1 and PSO2   |
| <b>CO5</b>                  | Studying about the NDT techniques are quite necessary for composite materials so it is mapped to PSO1 and PSO2  |
| <b>CO6</b>                  | Students should be able to do literature review on selected composites; hence it is mapped to PSO1 and PSO2   |

||Jai Sri Gurudev||  
**S.J.C. Institute of Technology, Chickballapur**  
**Department of Aeronautical Engineering**  
**List of V Sem B.E students 2019-20**

| Sl. No. | USN        | Name of the Student                    |
|---------|------------|--|
| 1.      | 1SJ17AE002 | ABHIJEET                               |
| 2.      | 1SJ17AE004 | AKASH H A                              |
| 3.      | 1SJ17AE005 | AKSHATA GUNDETT                        |
| 4.      | 1SJ17AE006 | AMRUTHA R                              |
| 5.      | 1SJ17AE007 | ANISHREE P                             |
| 6.      | 1SJ17AE008 | ARUN KUMAR                             |
| 7.      | 1SJ17AE009 | AVESODDIN SIDDIQUI FAHIMODDIN SIDDIQUI |
| 8.      | 1SJ17AE010 | BASAVARAJU B N                         |
| 9.      | 1SJ17AE011 | BHARATHI B                             |
| 10.     | 1SJ17AE012 | C H LOKESH                             |
| 11.     | 1SJ17AE013 | CHANDANA N                             |
| 12.     | 1SJ17AE014 | ERAGOWDA H G                           |
| 13.     | 1SJ17AE015 | FIRDOSE BANU                           |
| 14.     | 1SJ17AE016 | JAHANAVI R                             |
| 15.     | 1SJ17AE017 | JASON JFEVAN C J                       |
| 16.     | 1SJ17AE018 | KOJA SHREYAS PRAKASHI                  |
| 17.     | 1SJ17AE019 | KUMAR S                                |
| 18.     | 1SJ17AE020 | LOCHANA B M                            |
| 19.     | 1SJ17AE021 | MAGDUM ARIHANT RAJGONDA                |
| 20.     | 1SJ17AE022 | MAHESH D N                             |
| 21.     | 1SJ17AE023 | MALATHI S                              |
| 22.     | 1SJ17AE024 | MANOJ C                                |
| 23.     | 1SJ17AE025 | MFGHA MANNIKERI                        |
| 24.     | 1SJ17AE027 | MOHAN D C                              |
| 25.     | 1SJ17AE028 | NETHRA J                               |
| 26.     | 1SJ17AE029 | NIIHAL N                               |
| 27.     | 1SJ17AE030 | NIKHIL M                               |
| 28.     | 1SJ17AE031 | NISHAT MOMIN                           |
| 29.     | 1SJ17AE032 | PAVAN KALYAN B V                       |
| 30.     | 1SJ17AE033 | PRUTHIVJA P                            |
| 31.     | 1SJ17AE035 | SACHINREDDY                            |
| 32.     | 1SJ17AE036 | SANDEEP D                              |
| 33.     | 1SJ17AE037 | SANDEEP N                              |
| 34.     | 1SJ17AE039 | SATISH KUMAR H                         |
| 35.     | 1SJ17AE040 | SIDDHARTI CHANDRA CHOUDHARY            |
| 36.     | 1SJ17AE041 | SRIDEVI M HERLE                        |

|     |            |                 |
|-----|------------|-----------------|
| 37. | ISJ17AE042 | SUBHAM          |
| 38. | ISJ17AE043 | SUBHRA BERA     |
| 39. | ISJ17AE044 | SUHAS C         |
| 40. | ISJ17AE046 | VINEETH V       |
| 41. | ISJ17AE048 | NANDAN KUMAR .S |
| 42. | ISJ17AE049 | GURUMALLESH     |
| 43. | ISJ16AE002 | ABHILASH M      |
| 44. | ISJ16AE011 | CHAVAN DATTA    |
| 45. | ISJ16AE039 | SANJAY M        |

*Mithun*

MITHUN P.S

(Class In charge)

*(V Rajin)*  
29/7/15

PROFESSOR & HEAD  
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CHICKBALLAPUR-562101

USN

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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10AE52

**Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018**  
**Introduction to Composite Materials**

Time: 3 hrs.

Max. Marks:100

*Note: Answer any FIVE full questions, selecting  
atleast TWO questions from each part.*

## PART – A

- 1 a. Define composite material and list out how composite material are broadly classified with an example in each. (10 Marks)
- b. Write a note on laminated composite. (04 Marks)
- c. List the advantages and limitations of composite material. (06 Marks)
- 2 a. With neat sketch, explain hand layup moulding process. (08 Marks)
- b. Sketch and explain the spray up moulding process for polymer based composite. What are its advantages? (12 Marks)
- 3 a. Differentiate between pultrusion and pulforming. (04 Marks)
- b. With neat sketch label and explain :
  - i) Injection moulding
  - ii) Blow moulding. (16 Marks)
- 4 a. List the different types of composite joining process and explain any one process. (10 Marks)
- b. List the various methods used for cutting cured composite and explain abrasive waterjet cutting. (10 Marks)

## PART – B

- 5 a. Derive an relationship for stress strain for 2 –D plane stress in an orthotropic material. (10 Marks)
- b. Explain macromechanical failure theories and explain any one in detail. (10 Marks)
- 6 a. Define the term rule of mixture. Obtain the relationship for density of composite using rule of mixture. (10 Marks)
- b. A glass/ epoxy lamina with 70% fibre volume fraction. Take density of fibre  $\rho_f = 2500 \text{ kg/m}^3$  and density of matrix  $\rho_m = 1200 \text{ kg/m}^3$  determine : i) density of composite ii) mass fraction of glass and epoxy and sum of mass fraction. (06 Marks)
- c. Define : i) micromechanics ii) macromechanics. (04 Marks)
- 7 a. Obtain an expression for stress and strain variation in laminate. (10 Marks)
- b. Derive the expression for resultant laminate force and momentum using classical lamination theory. (10 Marks)
- 8 a. Discuss stir casting technique of producing metal matrix composite. (08 Marks)
- b. Explain any four characteristics of reinforcement material used in MMC's (08 Marks)
- c. List out various applications of MMC's (04 Marks)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg, 42+8 = 50, will be treated as malpractice.

**Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017**  
**Introduction to Composite Materials**

Time: 3 hrs

Max. Marks: 100

*Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.*

**PART - A**

1. a. Define composite material. How are they classified? (10 Marks)
- b. Explain clearly the role of matrix phase and reinforcement phase. (05 Marks)
- c. Justify the need of developing composite materials with aerospace applications. (05 Marks)
2. a. Sketch and explain typical epoxy curing cycle. (10 Marks)
- b. Explain following with neat sketch:
  - (i) Structural laminates
  - (ii) Pressure bag moulding
 (10 Marks)
3. a. Explain with neat sketch thermos forming and injection moulding process. (10 Marks)
- b. Discuss with sketch the liquid moulding and blow moulding. (10 Marks)
4. a. Explain water jet cutting of composite material. (10 Marks)
- b. With neat sketch, describe bonding process used in manufacturing of composite laminates. (10 Marks)

**PART - B**

5. a. Derive stress-strain relations for a lamina of arbitrary orientation. (10 Marks)
- b. Find the compliance and stiffness matrix for a graphite epoxy lamina, the material properties are given as:
 
$$E_1 = 181 \text{ GPa}, E_2 = 10.3 \text{ GPa}, E_3 = 10.3 \text{ GPa}, \nu_{12} = 0.28, \nu_{13} = 0.60, \nu_{23} = 0.2$$

$$G_{12} = 7.17 \text{ GPa}, G_{13} = 3.0 \text{ GPa}, G_{23} = 7.00 \text{ GPa}$$
 (10 Marks)
6. a. Derive an expression for the modulus of elasticity of PMC under iso-strain, iso-stress condition. (10 Marks)
- b. A Glass/epoxy lamina with 30% fiber volume fraction has following fiber and matrix properties:
 
$$E_f = 80 \text{ GPa}, E_m = 3.4 \text{ GPa}, \nu_f = 0.2, \nu_m = 0.3$$
 Find out following:
  - (i) In-plane shear modulus
  - (ii) Major and minor Poisson's ratio
 (10 Marks)
7. a. Explain C-E and derive expression for A, B and D matrices for laminate. (10 Marks)
- b. Compute [A], [B], [D] matrices for a  $\begin{bmatrix} 0 \\ 90 \end{bmatrix}$  laminate with the following properties: thickness of each lamina is 0.125 mm,  $E_1 = 140 \text{ GPa}$ ,  $E_2 = 10.0 \text{ GPa}$ ,  $\nu_{12} = 0.3$ ,  $G_{12} = 5 \text{ GPa}$ . (10 Marks)
8. a. What are MMC's? Mention type of matrix and reinforcement used. (05 Marks)
- b. Describe powder metallurgy technique. (10 Marks)
- c. List advantage, limitations and applications of MMC's. (05 Marks)

OR

- 8 a. Explain CTE and derive expression for A, B and D matrices for laminate (08 Marks)
- b. A tensile specimen of a unidirectional composite is prepared such that the fibers make an angle of  $5^\circ$  with the applied load. Determine the stress to cause failure according to
- The maximum stress criterion
  - The maximum strain criterion
- The following properties may be used
- $E_{11} = 76.0 \text{ GPa}$ ,  $E_{22} = 5.5 \text{ GPa}$ ,  $G_{12} = 2.35 \text{ GPa}$ ,  $\nu_{12} = 0.33$ ,  $\sigma_{11} = 1250 \text{ Mpa}$ ,  $\sigma_{21} = 30 \text{ MPa}$ ,  
 $\tau_{12} = 50 \text{ MPa}$ ,  $\sigma_{1c} = 1000 \text{ MPa}$ ,  $\sigma_{2c} = 100 \text{ MPa}$ . (08 Marks)

Module-5

- 9 a. List the NDT methods are normally used for testing FRP. (06 Marks)
- b. Explain following inspection and quality control methods.
- Hardness testing
  - Ultrasonic inspection (10 Marks)

OR

- 10 Write a note on application of composite materials on the following industry:
- Automobile
  - Aircraft
  - Electrical and electronics
  - Sports (16 Marks)

\* \* \* \* \*



| DEPARTMENT : AERONAUTICAL ENGINEERING   |   |   |                      |             |                     |           |
|---|---|---|----------------------|-------------|---------------------|-----------|
| LESSON PLAN   |   |   |                      |             |                     |           |
| CLASS:5 <sup>th</sup> SEM<br>SECTION: A   | FACULTY:<br>Dr. BINO PRINCE RAJA.D  | SUBJECT:<br>Introduction to Composite Materials |                      |             | SUB CODE:<br>17AE52 |           |
| OBJECTIVE: This course will enable students to  |   |   |                      |             |                     |           |
| <ol style="list-style-type: none"> <li>Understand the advantages of composite materials compared to conventional materials</li> <li>Evaluate the properties of polymer matrix composites with fiber reinforcements</li> <li>Explain the manufacturing process and applications of composite materials</li> </ol>  |   |   |                      |             |                     |           |
| PREREQUISITES:  |   |   |                      |             |                     |           |
| EXPECTED OUTCOME: After studying this course, students will be able to:   |   |   |                      |             |                     |           |
| <ol style="list-style-type: none"> <li>Understand the concept of composite materials over monolithic materials, as well as some basic knowledge about constituents of composite materials (L3)</li> <li>Examine the properties of fiber and matrix materials used in commercial applications. The different fabrication techniques, which is used to investigate the PMC, CMC and MMC composites (L2)</li> <li>Ability to analyze problems on micro-mechanical and macro-mechanical behavior of lamina (L3)</li> <li>Predict the failure strength of a laminated composite plate and identify the suitable machining method for a given type of laminate (L3)</li> <li>Analyzing the failure using NDT technique and able to perform different types of characterization such as tensile, flexural, impact and hardness test etc.(L3)</li> <li>Ability to perform literature review on a selected advanced composite material topic and should be able to give demo in class(L2)</li> </ol> |   |   |                      |             |                     |           |
| IT IS BASIC SUBJECT FOR: Advanced composite materials   |   |   |                      |             |                     |           |
| SUBJECT APPLICATIONS: Aircraft Structures and its components  |   |   |                      |             |                     |           |
| Sl no.  | TOPIC   | PLANNED   |                      | ACTUAL      |                     | REMARKS   |
|   |   | No of Hours                                     | Date                 | No of Hours | Date                |           |
| 1.  | Module- Introduction to Composite Materials<br>Definition, classification of composite materials, classification of reinforcements. | 02  | 29/07/19<br>31/07/19 | 01          | 31/07               | Executed  |
| 2.  | Particulate, short fiber, whiskers, long fibers composites  | 01  | 01/08                | 01          | 01/08               | Executed  |
| 3.  | Matrix materials – metals.  | 01  | 02/08                | 01          | 02/08               | Completed |
| 4.  | Ceramics, polymers (including thermoplastics and thermosets),   | 01  | 05/08                | 01          | 07/08               | Completed |
| 5.  | Carbon-Carbon Composites  | 01  | 07/08                | 01          | 08/08               | Completed |
| 6.  | Metal Matrix Composites:<br>MMC with particulate and short fiber reinforcement,   | 02  | 08/08, 09/08         | 01          | 16/08               | Completed |



|     |   |    |                 |    |                |           |
|-----|---|----|-----------------|----|----------------|-----------|
| 7.  | Liquid and solid state processing of MMC  | 01 | 14/08           | 01 | 19/08          | Completed |
| 8.  | Stir casting, squeeze casting. Properties of MMCs   | 02 | 16/08,1<br>9/08 | 01 | 20/08          | Completed |
| 9.  | <b>Module -2</b><br><b>Processing of Polymer Matrix Composites:</b><br><b>Thermoset Polymers-Introduction</b> | 02 | 21/08,2<br>2/08 | 02 | 22/08<br>23/08 | Completed |
| 10. | Hand layup Process, Vacuum Bagging Process  | 01 | 23/08           | 01 | 26/08          | Completed |
| 11. | Post Curing Process, Filament winding   | 01 | 28/08           | 01 | 28/08          | Completed |
| 12. | Pultrusion, Pulforming, Autoclave Process   | 02 | 29/08,3<br>0/08 | 01 | 29/08          | Completed |
| 13. | <b>Processing of Polymer Matrix Composites:</b><br>Thermoplastic Polymers                                     | 01 | 04/09           | 01 | 3/09           | Completed |
| 14. | Extrusion process, Injection Moulding Process.  | 01 | 05/09           | 01 | 04/09          | Completed |
| 15. | Thermo-forming process.   | 01 | 06/09           | 01 | 06/09          | Completed |
| 16. | Adhesive  | 01 | 09/09           | 01 | 09/09          | Completed |
| 17. | <b>Post Processing of Composites</b> -bonding, drilling.  | 01 | 11/09           | 01 | 11/09          | Completed |
|     | <b>Tutorial-I (06/09/19)</b>  |    |                 |    |                |           |
|     | <b>INTERNAL TEST-I (12/09-14/09)</b>  |    |                 |    |                |           |
| 18. | <b>Module -3</b><br><b>Micro-Mechanical Behavior of a Lamina</b><br>Determination of elastic constants.       | 01 | 16/09           | 01 | 16/09          | Completed |
| 19. | Rule of mixtures ,transformation of coordinates   | 01 | 18/09           | 01 | 16/09          | Completed |
| 20. | Micro-mechanics based analysis and experimental determination of material constants                           | 02 | 19.20/0<br>9    | 01 | 18/09          | Completed |
| 21. | <b>Macro-Mechanical Behavior of a Lamina:</b><br>Global and local axis for angle lamina                       | 02 | 23.25/0<br>9    | 01 | 18/09          | Completed |
| 22. | Determination of global and local stresses and moduli   | 02 | 26.27/0<br>9    | 01 | 19/09          | Completed |
| 23. | 2D-UD lamina with different fiber orientation   | 01 | 30/09           | 01 | 19/09          | Completed |
| 24. | Different fiber materials glass, carbon and aramid fiber  | 02 | 03/10,0<br>4/10 | 01 | 23/09          | Completed |
| 25. | <b>Module -4</b><br>Failure Theory - Tsai-Hill, Tsai-Wu   | 02 | 09/10,1<br>0/10 | 01 | 24/09          | Completed |
| 26. | Max Stress and Max Strain theory  | 01 | 14/10           | 01 | 27/09          | Completed |
| 27. | Classical plate theory- Stress and strain variation in  | 01 | 16/10           | 01 | 30/09          | Completed |



|     |   |    |             |    |                |           |
|-----|---|----|-------------|----|----------------|-----------|
|     | a laminate  |    |             |    |                |           |
|     | <b>Tutorial-II (11/10/19)</b>   |    |             |    |                |           |
|     | <b>INTERNAL TEST-II (17/10-19/10)</b>   |    |             |    |                |           |
| 28. | Resultant forces and moments- A B & D matrices  | 02 | 21/10,23/10 | 02 | 10/11/10       | Completed |
| 29. | Strength analysis of a laminate   | 02 | 24,25/10,   | 02 | 13/16/10       | Completed |
| 30. | <b>Module -5</b><br><b>Inspection &amp; Quality Control : Destructive &amp; Non-Destructive Testing</b> | 02 | 28,30/10    | 02 | 21/10<br>24/10 | Completed |
| 31. | Tensile, Compression, Flexural test   | 02 | 31/10,04/11 | 02 | 30/10<br>31/10 | Completed |
| 32. | Shear, Hardness test  | 02 | 06,07/11    | 02 | 04/11<br>06/11 | Completed |
| 33. | Ultrasonic testing – A-B-C scan   | 02 | 08,11/11    | 01 | 11/11          | Completed |
| 34. | <b>Applications of Composites Materials</b><br>Automobile, Aircrafts, missiles                          | 02 | 13,18/11    | 01 | 14/11          | Completed |
| 35. | Space hardware, Electrical and electronics, marine,   | 02 | 20,25/11    | 01 | 18/11          | Completed |
| 36. | Recreational and Sports equipment,  | 02 | 27,28/11    | 01 | 20/11          | Completed |
| 37. | future potential of composites.   | 01 | 29/11       | 01 | 21/11          | Completed |
|     | <b>Tutorial-III (14/11/19)</b>  |    |             |    |                |           |
|     | <b>Internals-III (21/11-23/11)</b>  |    |             |    |                |           |

Assignments and Mini Project

|                                |  |
|--------------------------------|--|
| Assignment – I<br>Submit By:   | Assignment on Polymer matrix Composites with aerospace applications                    |
| Assignment – II<br>Submit By:  | Experimental Characterization<br>ii) Tensile longitudinal<br>(i) Compression and shear |
| Assignment – III<br>Submit By: | ABD Matrix,<br>E <sub>1</sub> & E <sub>2</sub> , CLT                                   |



|                            |  |
|----------------------------|--|
| Mini Project<br>Submit By: |  |
|----------------------------|--|

Literature to be Referred for the Course:

| Book Type       | Code | Title & Author   | Publication Information |                            |      |
|-----------------|------|--|-------------------------|----------------------------|------|
|                 |      |  | Edition                 | Publisher                  | Year |
| Text Books      | T1   | K.K Chawla, "Composite Materials- Science and Engineering"     | 2nd edition             | Springer Verlag            | 1998 |
|                 | T2   | Autar Kaw, "Mechanics of Composites"                           | 2nd edition             | CRC Press                  | 2006 |
| Reference Books | R1   | Mein Schwartz, "Composite Materials Handbook"                  | Vol.3                   | Department of Defense, USA | 2002 |
|                 | R2   | Ajay Kapadia, "Non-Destructive Testing of Composite Materials" | 4 <sup>th</sup> edition | TWI publications           | 2006 |
|                 | R3   | R M Jones, "Mechanics of Composite Materials",                 | 2nd edition             | Taylor & Francis           | 2015 |

Comments by Faculty:

Completed all the modules within the stipulated period

Comments by HOD:

|             |                           |             |                |             |  |
|-------------|---------------------------|-------------|----------------|-------------|--|
| Prepared by | Dr. Bino PRIME<br>Raja .D | Reviewed by | MITHUN PT      | Approved by |  |
| Date&sign   | Bino<br>29/7/19           | Date&sign   | MPT<br>29/7/19 | Date&sign   |  |

29/7/19.

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S J C INSTITUTE OF TECHNOLOGY, CHICKBALLAPUR  
Department of Aeronautical Engineering

## Assignment Rubrics


Subject Name: Introduction to Composite Materials  
Subject Code: 17AE52

Semester & Section: V  
Faculty Name: Dr. Bino Prince Raja.D

Period: 29/7/2019 to 30/11/2019  
Assignment Marks: 10 Marks

| Symbolic Representation of Rubrics | Marks Indication  | Total |
|------------------------------------|---|-------|
| A                                  | Answer up to the question / Description<br>( 1 – 2) Marks | 2     |
| B                                  | Examples / Figures /<br>(1 – 2) Marks                     | 2     |
| C                                  | Problem Solution Steps / Calculations<br>(1-2) Marks      | 2     |
| D                                  | Quiz  | 4     |
|                                    | Final Marks   | 10    |

Bino Prince Raja.D  
29/07/19  
Staff Signature

  
HOD  
(V Rayan)  
29/7/19

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CHICKBALLAPUR-562101

//JAI SRI GURUDEV//  
**S.J.C INSTITUTE OF TECHNOLOGY**  
**DEPARTMENT OF AERONAUTICAL ENGINEERING**

**Introduction to Composite Materials (17AE52)**  
**Tutorials-I**

| Sl. No.          | Questions   | CO  | Levels |
|------------------|---|-----|--------|
| <b>MODULE-I</b>  |   |     |        |
| 1.               | Explain about composite materials. How are they classified?   | CO1 | L2     |
| 2.               | Explain about the role of matrix phase and reinforcement phase.   | CO1 | L2     |
| 3.               | Describe the need of developing composite materials with aerospace applications in focus.                   | CO1 | L2     |
| 4.               | List the advantages and disadvantages of composite materials.   | CO1 | L2     |
| 5.               | Describe PMC. Explain briefly about its classification, advantages and disadvantages.                       | CO1 | L2     |
| 6.               | List and explain the desirable characteristics of fiber reinforced composites. Mention applications of PMCs | CO1 | L2     |
| 7.               | Describe MMC. Explain briefly about its classification, advantages and disadvantages.                       | CO1 | L2     |
| 8.               | Describe CMC. Explain briefly about its classification, advantages and disadvantages.                       | CO1 | L2     |
| 9.               | Distinguish between thermoplastics and thermosets.  | CO1 | L2     |
| 10.              | Explain carbon-carbon composites. Mention its applications.   | CO1 | L2     |
| 11.              | Describe MMC. Write the type of matrix and reinforcement used in their manufacturing.                       | CO1 | L2     |
| 12.              | Explain the Liquid metallurgy technique used manufacturing of MMC's.  | CO1 | L2     |
| 13.              | Explain the properties and applications of Al, Mg and Ti based MMC.   | CO1 | L2     |
| <b>MODULE-II</b> |   |     |        |
| 14.              | Illustrate and explain typical epoxy curing cycle.  | CO2 | L2     |

|     |  |     |    |
|-----|--|-----|----|
| 15. | Discuss the following techniques of processing composites and list the merits and demerits<br>i) Pultrusion                      ii) Filament winding  | CO2 | L2 |
| 16. | Explain hand lay-up technique and vacuum bag molding technique with neat sketch.   | CO2 | L2 |
| 17. | Discuss the following techniques of processing composites and list the merits and demerits<br>i) Pulforming                      ii) Autoclave Process | CO2 | L2 |
| 18. | Explain water jet cutting of composites  | CO2 | L2 |
| 19. | Explain with neat sketches injection moulding, thermoforming process and Extrusion process.  | CO2 | L2 |
| 20. | List the difficulties are faced in the machining of FRP's. Explain Cutting operation for PMC's.  | CO2 | L2 |
| 21. | Explain the adhesive bonding and drilling process.   | CO2 | L2 |

*Bim*  
06/09/19

Staff      Incharge

*Mess*  
6/9/19  
Reviewer



**Internal Test Question paper**

Name of the staff/s: **Dr. BINO PRINCE RAJA.D**

Date: 03/09/2019 Signature: *Bino*  
*03/09/19*

Reviewer's Signature: *Umm*  
*319*

**S.J.C. Institute of Technology**  
**Department of Aeronautical Engineering**  
**Test: I**  
**Semester: V**

**Subject Name & Code:** Introduction to Composite Materials - 17AE52

Duration: 90 Minutes

Max Marks: 30

**NOTE:** 1. Answer all three main questions, choosing one full question from each main

2. Missing data if any, can be suitably assumed

| Question Number |  | Marks | CO  | Levels |
|-----------------|--|-------|-----|--------|
| 1               | a. Define composite materials. How are they classified? Explain in detail.   | 05    | CO1 | L-2    |
|                 | a. Explain carbon-carbon composites. Mention its applications.   | 05    | CO1 | L-2    |
| <b>OR</b>       |  |       |     |        |
| 2               | b. Explain the Liquid metallurgy technique used for manufacturing of MMC's.  | 05    | CO1 | L-2    |
|                 | a. Define PMC. Explain briefly about its classification, advantages and disadvantages.   | 05    | CO1 | L-2    |
| 3               | a) Explain with neat sketches injection moulding and Extrusion process.  | 05    | CO2 | L-2    |
|                 | b) Discuss the following techniques of processing composites and list the merits and demerits<br>i) Pulforming ii) Autoclave Process | 05    | CO2 | L-2    |
| <b>OR</b>       |  |       |     |        |
| 4               | a. Explain water jet cutting of composites   | 05    | CO2 | L-2    |



|   |   |    |     |     |
|---|---|----|-----|-----|
|   | b. List the difficulties are faced in the machining of FRP's.<br>Explain Cutting operation for PMC's.   | 05 | CO2 | L-2 |
| 5 | Explain hand lay-up technique and vacuum bag molding technique with neat sketch.  | 10 | CO2 | L-2 |
|   | <b>OR</b>   |    |     |     |
| 6 | Discuss the following techniques of processing composites and list the merits and demerits<br>i) Pultrusion                      ii) Filament winding | 10 | CO2 | L-2 |

**COURSE OUTCOMES:**

**On successful completion of this course, students should be able to**

|            |   |
|------------|---|
| <b>C01</b> | Understand the concept of composite materials over monolithic materials, as well as some basic knowledge about constituents of composite materials (L2)                                       |
| <b>C02</b> | Examine the properties of fiber and matrix materials used in commercial applications. The different fabrication techniques, which is used to investigate the PMC, CMC and MMC composites (L2) |
| <b>C03</b> | Ability to analyze problems on micro-mechanical and macro-mechanical behavior of lamina (L3)  |
| <b>C04</b> | Predict the failure strength of a laminated composite plate and identify the suitable machining method for a given type of laminate (L3)  |
| <b>C05</b> | Analyzing the failure using NDT technique and able to perform different types of characterization such as tensile, flexural, impact and hardness test etc.(L3)                                |
| <b>C06</b> | Ability to perform literature review on a selected advanced composite material topic and should be able to give demo in class(L2)   |

**DEPARTMENT: AERONAUTICAL ENGINEERING**

**Scheme & Solutions- TEST- I/II/III**

Date: 03/09/19

Semester: V

Subject Title: Introduction to Composite Materials Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated                         |
|-----------------|---|---|
| 1 a.)           | <p><u>Composite Materials</u></p> <p>A Composite materials can be defined as a combination of two or more constituent materials with different physical or chemical properties, and which remain separate and distinct on a microscopic (or) macroscopic level. 2 types.</p> <p>i.) Matrix }<br/>                     (ii) Reinforcement }</p> <p>Explanation . . . . .</p>   | <p>02</p> <p>01</p> <p>01</p> <p>01</p> |
| b.)             | <p><u>Carbon - Carbon Composites (C-C)</u></p> <p>C-C Composites are structures in which both the matrix and Reinforcement are made of carbon alloy only.</p> <p><u>Adv</u> (*) Density is 1.5 to 2.0 g/cc<br/>                     (*) Temperature capacity of 2200°C</p> <p><u>Dis-Adv</u> (*) Lack of Oxidation Resistance</p> <p><u>Applications</u> (*) Military &amp; Aerospace requirements<br/>                     (*) Heat Shields</p> <p>Explanation . . . . .</p> | <p>02</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated                                   |
|-----------------|---|---|
| 2 a.)           | <p><u>Liquid Metallurgy</u> <u>Technique</u></p> <p>Metals with melting point temperature that are not too high can be incorporated easily as a matrix by liquid route - 2 techniques</p> <p>i.) Stir Casting . . . . .</p> <p>(i.) Squeeze Casting . . . . .</p> <p>Diagram and explanation . . . . .</p>  | <p>02</p> <p>01</p> <p>01</p> <p>01</p>           |
| b.)             | <p><u>Polymer Matrix Composites (PMC)</u></p> <p>If the matrix is made from polymer resin material, then it is said to be PMC. 2 types</p> <p>1.) Thermoplastic } . . . . .</p> <p>(i.) Thermosetting }</p> <p><u>Advan</u></p> <p>(*) Low cost</p> <p>(*) Low density</p> <p>(*) Superior chemical resistance</p> <p><u>Dis-advan</u></p> <p>(+) Low strength</p> <p>(+) Low modulus</p> <p>(*) Limited range of operating temp</p> <p><u>Appln</u></p> <p>(*) Aerospace</p> <p>(*) Automobile</p> | <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
| 3 a.)           | <p><u>Injection moulding Process</u></p> <p>In this process, molten Polymer is mixed with very short fibres &amp; injected under high pressure into a mould cavity having the desired shape of component</p> <p>Diagram . . . . . 01</p> <p>Advant &amp; Dis-Adv } . . . . . 01</p> <p>Appln</p> <p><u>EXTRUSION Process</u></p> <p>Diagram . . . . . 01</p> <p>Adv &amp; Dis-Adv } . . . . . 01</p> <p>Appln</p>                                |                 |
| b.)             | <p><u>Pulforming</u></p> <p>Pulforming is same as the Pultrusion but variation is in Pultrusion only shapes with constant cross section.</p> <p>Advan } . . . . . 01</p> <p>Dis-Advan } . . . . . 01</p> <p>Appln . . . . . 01</p> <p><u>Autoclave</u></p> <p>An autoclave is simply a large, heated pressure vessels used to carry industrial process at elevated Temp &amp; Pressure.</p> <p>Adva &amp; Disadv } . . . . . 01</p> <p>Appln</p> |                 |



Subject Title: Icm

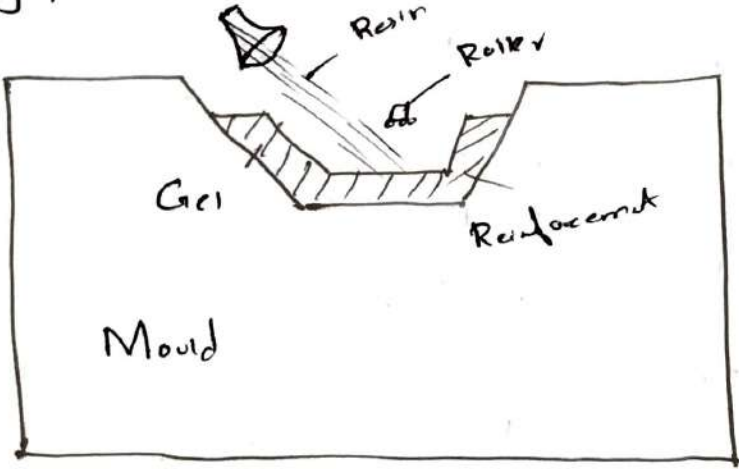
Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated                         |
|-----------------|---|---|
| H a.)           | <p><u>Water Jet Cutting</u></p> <p>Water jet uses an ultra high pressure focused stream of water (dia - 0.25mm) and velocity 803 m/s to cut the piece</p> <p><u>Advan</u></p> <p>(+) No Dust<br/>(*) upto 10 plies can be cut</p> <p><u>Dis-Adv</u></p> <p>(*) Slight moisture pickup<br/>(*) Expensive</p> <p><u>Appln</u> - - - -</p>   | <p>02</p> <p>01</p> <p>01</p> <p>01</p> |
| H b.)           | <p><u>Difficulties in the machining of FRP</u></p> <p>(*) The non traditional machining operations such as laser machining, water jet and abrasive waterjet, electrical discharge machining, ultrasonic assisted machining</p> <p><u>Advan</u></p> <p>(+) Time consuming<br/>(*) Cut dimensions<br/>(*) Cut edges</p> <p><u>Dis-Adv</u></p> <p>(+) High cost</p> <p><u>Appln</u></p> <p>FRP materials</p> | <p>02</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated                                   |
|-----------------|--|---|
| 5.)             | <p><u>Hand lay-up technique</u></p> <p>The simplest and oldest method of fabrication of PMCs is hand layup process.</p>  <p><u>Process</u></p> <p>Gel Coating → Resin → Fiber → Roller → Final Product</p> <p><u>Advant</u></p> <p>i.) Simple in Operation<br/> ii.) Low investment &amp; manufacture cost</p> <p><u>Dis-Adv</u></p> <p>(+) Longer Cure times<br/> (+) Low volume</p> <p><u>Appin</u></p> <p>Boat hulls, tanks, buildings</p> | <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated                         |
|-----------------|---|---|
|                 | <p><u>Vacuum Bagging Process</u></p> <p>Mould having the shape of the desired Part is Prepared Suitably</p> <p>Process Prepreg material → Sheet or Bag<br/>Vacuum → Resin Injection → Cure</p> <p>Advan (+) Simple Design<br/>(*) Any fibre matrix can be used</p> <p>Dis-Adv (-) Labour Intensive</p> <p>Appln Radomes, helmets, Simple.</p> | <p>01</p> <p>01</p> <p>01</p> <p>01</p> |
| <p>6.7</p>      | <p><u>Pultrusion</u></p> <p>In this Process Continuous Sections of Polymer matrix Composites with fibres oriented mainly axially are Produced</p> <p>Diagram . . . . .</p> <p>Advan (+) Automated Process<br/>(*) Low waste</p> <p>Dis-Adv (-) Good surface quality<br/>(*) High Investment Cost<br/>(*) long tooling time</p>                | <p>01</p> <p>01</p> <p>01</p>           |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated |
|-----------------|---|-----------------|
|                 | <p><u>Application</u></p> <p>i) I-beams, channels, tubes<br/>           (ii) Fishing rods</p>   | 01              |
|                 | <p><u>Filament Winding</u></p> <p>It is a Versatile technique in which continuous tow (or) roving is passed through a Resin impregnator bath and Wound over a rotating or Stationary Mandrel.</p> | 01              |
|                 | <p><u>Process</u></p> <p>Fiber creel → Moving Carriage<br/>           → Resin bath → mandrel → Final Product</p>  | 01              |
|                 | <p><u>Advantages</u></p> <p>i.) Excellent mechanical Properties<br/>           (ii) High Strength to weight ratio</p>   | 01              |
|                 | <p><u>Dis-Advantages</u></p> <p>i.) High Cost<br/>           ii) Only Smooth Surface can be obtained</p>  | 01              |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
|                 | <p><u>Applications</u></p> <p>(*) Storage tanks, Pipelines</p> <p>(*) Gas cylinders etc-</p><br><p><u>Reviewer</u><br/>3/9/19</p> <p><u>HOD</u><br/>8/9/19</p> <p><u>Staff incharge</u><br/>03/09/19</p> | <p>01</p>       |

|| Jai Sri Gurudev ||  
**S.J.C. Institute of Technology, Chickballapur**  
**Department of Aeronautical Engineering**  
**Rubrics-I**

**Subject: Introduction to Composite Materials**

**Subject code: 17AE52**

| Sl. No. | USN        | NAME OF THE STUDENT                       | A | B | C | D | Total |
|---------|------------|---|---|---|---|---|-------|
| 1       | 1SJ17AE002 | ABHIJEET                                  | 4 | 1 | 4 | 1 | 10    |
| 2       | 1SJ17AE004 | AKASH H A                                 | 4 | 1 | 4 | 1 | 10    |
| 3       | 1SJ17AE005 | AKSHATA GUNDETI                           | 4 | 1 | 4 | 1 | 10    |
| 4       | 1SJ17AE006 | AMRUTHA R                                 | 4 | 1 | 4 | 0 | 09    |
| 5       | 1SJ17AE007 | ANISHREE P                                | 4 | 1 | 4 | 1 | 10    |
| 6       | 1SJ17AE008 | ARUN KUMAR                                | A | A | A | A | A     |
| 7       | 1SJ17AE009 | AVESODDIN SIDDIQUI<br>FAHIMODDIN SIDDIQUI | 4 | 1 | 4 | 0 | 09    |
| 8       | 1SJ17AE010 | BASAVARAJU B N                            | 4 | 1 | 4 | 1 | 10    |
| 9       | 1SJ17AE011 | BHARATH B                                 | 4 | 1 | 4 | 1 | 10    |
| 10      | 1SJ17AE012 | C H LOKESH                                | 4 | 1 | 4 | 1 | 10    |
| 11      | 1SJ17AE013 | CHANDANA N                                | 4 | 1 | 4 | 1 | 10    |
| 12      | 1SJ17AE014 | ERAGOWDA H G                              | 4 | 1 | 4 | 1 | 10    |
| 13      | 1SJ17AE015 | FIRDOSE BANU                              | 4 | 1 | 4 | 1 | 10    |
| 14      | 1SJ17AE016 | JAHANAVI R                                | 4 | 1 | 4 | 0 | 09    |
| 15      | 1SJ17AE017 | JASON JEEVAN C J                          | 4 | 1 | 4 | 1 | 10    |
| 16      | 1SJ17AE018 | KOTA SHREYAS PRAKASH                      | 4 | 1 | 4 | 1 | 10    |
| 17      | 1SJ17AE019 | KUMAR S                                   | 4 | 1 | 4 | 1 | 10    |
| 18      | 1SJ17AE020 | LOCHANA B M                               | 4 | 1 | 4 | 1 | 10    |
| 19      | 1SJ17AE021 | MAGDUM ARIHANT<br>RAJGONDA                | 4 | 1 | 4 | 0 | 09    |
| 20      | 1SJ17AE022 | MAHESH D N                                | 4 | 1 | 4 | 1 | 10    |
| 21      | 1SJ17AE023 | MALATHI S                                 | 4 | 1 | 4 | 1 | 10    |
| 22      | 1SJ17AE024 | MANOJ C                                   | 4 | 1 | 4 | 1 | 10    |
| 23      | 1SJ17AE025 | MEGHA MANNIKERI                           | 4 | 1 | 4 | 1 | 10    |
| 24      | 1SJ17AE027 | MOHAN D C                                 | 4 | 1 | 3 | 0 | 08    |

|    |            |                                |   |   |   |   |    |
|----|------------|--------------------------------|---|---|---|---|----|
| 25 | 1SJ17AE028 | NETHRA J                       | 4 | 1 | 4 | 1 | 10 |
| 26 | 1SJ17AE029 | NIHAL N                        | 4 | 1 | 4 | 1 | 10 |
| 27 | 1SJ17AE030 | NIKHIL M                       | 4 | 1 | 4 | 1 | 10 |
| 28 | 1SJ17AE031 | NISHAT MOMIN                   | 4 | 1 | 4 | 1 | 10 |
| 29 | 1SJ17AE032 | PAVAN KALYAN B V               | 4 | 1 | 4 | 1 | 10 |
| 30 | 1SJ17AE033 | PRUTHVIJA P                    | 4 | 1 | 4 | 0 | 09 |
| 31 | 1SJ17AE035 | SACHINREDDY                    | 4 | 1 | 4 | 1 | 10 |
| 32 | 1SJ17AE036 | SANDEEP D                      | 4 | 1 | 4 | 1 | 10 |
| 33 | 1SJ17AE037 | SANDEEP N                      | 4 | 1 | 4 | 1 | 10 |
| 34 | 1SJ17AE039 | SATISH KUMAR H                 | 4 | 1 | 4 | 1 | 10 |
| 35 | 1SJ17AE040 | SIDDHARTH CHANDRA<br>CHOUDHARY | 4 | 1 | 4 | 0 | 09 |
| 36 | 1SJ17AE041 | SRIDEVI M HERLE                | 4 | 1 | 4 | 1 | 10 |
| 37 | 1SJ17AE042 | SUBHAM                         | 4 | 1 | 4 | 1 | 10 |
| 38 | 1SJ17AE043 | SUBHRA BERA                    | 4 | 1 | 3 | 0 | 08 |
| 39 | 1SJ17AE044 | SUHAS C                        | 4 | 1 | 4 | 1 | 10 |
| 40 | 1SJ17AE046 | VINEETH V                      | A | A | A | A | A  |
| 41 | 1SJ16AE002 | ABHILASH M                     | 4 | 1 | 4 | 1 | 10 |
| 43 | 1SJ17AE049 | GURUMALLESH                    | 4 | 1 | 4 | 0 | 09 |
| 44 | 1SJ17AE048 | NANDAN KUMAR S                 | 4 | 1 | 4 | 0 | 09 |

**A = Description for the answer B = Figures or Diagrams C = Numericals and derivations  
D = Timely submission**

*By*  
*25/11/17*

Name of the staff: Dr. BINO PRINCE RAJA.D

Subject: Introduction to composite materials

 Sub code: 17AE52  
 Mapping of CO matrix with Test- Question Papers (IA-2)

Semester: V

| Sl.No | USN        | Name  | CO's   |      |      |      |      |      |      |      |      |      | Total Marks |    |    |
|-------|------------|---|--------|------|------|------|------|------|------|------|------|------|-------------|----|----|
|       |            |   | CO 3   | CO 3 | CO 3 | CO 3 | CO 3 | CO 3 | CO 3 | CO 3 | CO 3 | CO 3 |             |    |    |
|       |            |   | 3      | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3    | 3           | 3  | 30 |
|       |            |   | 10     | 10   | 6    | 4    | 6    | 4    | 6    | 4    | 4    | 4    | 10          | 10 |    |
|       |            |   | 1      | 2    | 3a   | 3b   | 4a   | 4b   | 5    | 5    | 6    | 6    | 6           | 6  |    |
| 1.    | 1SJ16AE002 | ABHILASH .M                                     | 10     |      | 6    | 4    |      |      |      |      |      |      | 10          | 30 |    |
| 2.    | 1SJ16AE011 | CHAVAN DATTA                                    | ABSENT |      |      |      |      |      |      |      |      |      |             |    |    |
| 3.    | 1SJ16AE039 | SANJAY M  |        |      |      |      |      |      |      |      |      |      |             |    |    |
| 4.    | 1SJ17AE002 | ABHIJEET  | 10     |      | 6    | 4    |      |      |      |      |      |      | 10          | 30 |    |
| 5.    | 1SJ17AE004 | AKASH H A                                       | 10     |      | 6    | 4    |      |      |      |      |      |      | 10          | 30 |    |
| 6.    | 1SJ17AE005 | AKSHATA GUNDETI                                 | 7      |      | 6    | 4    |      |      |      |      |      |      | 9           | 26 |    |
| 7.    | 1SJ17AE006 | AMRUTHA R                                       |        | 10   | 6    | 4    |      |      |      |      |      |      | 10          | 30 |    |
| 8.    | 1SJ17AE007 | ANISHREE P                                      | ABSENT |      |      |      |      |      |      |      |      |      |             |    |    |
| 9.    | 1SJ17AE008 | ARUN KUMAR                                      | ABSENT |      |      |      |      |      |      |      |      |      |             |    |    |
| 10.   | 1SJ17AE009 | AVESODDIN<br>SIDDIQUI<br>FAHIMODDIN<br>SIDDIQUI |        |      |      |      |      |      |      |      |      |      | 9           | 29 |    |
| 11.   | 1SJ17AE010 | BASAVARAJU B N                                  | 10     |      | 6    | 4    |      |      |      |      |      | 9    | 28          |    |    |
| 12.   | 1SJ17AE011 | BHARATH B                                       | 10     |      | 6    | 4    |      |      |      |      |      | 10   | 30          |    |    |
| 13.   | 1SJ17AE012 | C H LOKESH                                      |        | 9    | 6    | 4    |      |      |      |      |      | 8    | 27          |    |    |
| 14.   | 1SJ17AE013 | CHANDANA N                                      | 10     |      | 6    | 4    |      |      |      |      |      | 10   | 30          |    |    |
| 15.   | 1SJ17AE014 | ERAGOWDA H G                                    | 10     |      | 6    | 4    |      |      |      |      |      | 9    | 29          |    |    |
| 16.   | 1SJ17AE015 | FIRDOSE BANU                                    |        | 9    | 6    | 4    |      |      |      |      |      | 10   | 29          |    |    |
| 17.   | 1SJ17AE016 | JAHANAVIR                                       |        | 8    | 6    | 4    |      |      |      |      |      |      | 18          |    |    |



|     |            |                             |    |  |  |    |   |   |  |  |  |    |    |    |
|-----|------------|-----------------------------|----|--|--|----|---|---|--|--|--|----|----|----|
| 18. | ISJ17AE017 | JASON JEEVAN C J            |    |  |  | 10 | 6 | 4 |  |  |  |    | 8  | 28 |
| 19. | ISJ17AE018 | KOTA SHREYAS PRAKASH        |    |  |  | 10 | 6 | 4 |  |  |  | 7  |    | 27 |
| 20. | ISJ17AE019 | KUMAR S                     | 8  |  |  |    | 4 | 2 |  |  |  | 6  |    | 20 |
| 21. | ISJ17AE020 | LOCHANA B M                 |    |  |  | 10 | 4 | 4 |  |  |  |    | 9  | 27 |
| 22. | ISJ17AE021 | MAGDUM ARIHANT RAJGONDA     |    |  |  | 10 | 6 | 4 |  |  |  | 4  |    | 24 |
| 23. | ISJ17AE022 | MAHESH D N                  | 10 |  |  |    | 6 | 4 |  |  |  |    | 9  | 29 |
| 24. | ISJ17AE023 | MALATHI S                   |    |  |  | 9  | 6 | 4 |  |  |  |    | 10 | 29 |
| 25. | ISJ17AE024 | MANOJ C                     |    |  |  | 8  | 6 | 2 |  |  |  | 6  |    | 22 |
| 26. | ISJ17AE025 | MEGHA MANNIKERI             | 10 |  |  |    | 6 | 4 |  |  |  | 7  |    | 21 |
| 27. | ISJ17AE027 | MOHAN D C                   |    |  |  | 9  | 6 | 1 |  |  |  |    |    | 16 |
| 28. | ISJ17AE028 | NETHRA J                    | 10 |  |  |    | 6 | 4 |  |  |  | 10 |    | 30 |
| 29. | ISJ17AE029 | NIHAL N                     | 8  |  |  |    | 6 | 4 |  |  |  |    | 9  | 27 |
| 30. | ISJ17AE030 | NIKHIL M                    |    |  |  | 10 | 6 | 4 |  |  |  | 8  |    | 28 |
| 31. | ISJ17AE031 | NISHAT MOMIN                |    |  |  | 10 | 6 | 4 |  |  |  |    | 10 | 30 |
| 32. | ISJ17AE032 | PAVAN KALYAN B V            | 9  |  |  |    | 6 | 4 |  |  |  | 5  |    | 24 |
| 33. | ISJ17AE033 | PRUTHVIJA P                 |    |  |  | 10 | 6 | 3 |  |  |  |    | 10 | 29 |
| 34. | ISJ17AE035 | SACHINREDDY                 | 10 |  |  |    | 6 | 4 |  |  |  |    | 9  | 29 |
| 35. | ISJ17AE036 | SANDEEP D                   |    |  |  | 10 | 6 | 4 |  |  |  | 6  |    | 26 |
| 36. | ISJ17AE037 | SANDEEP N                   |    |  |  | 9  | 6 | 4 |  |  |  |    | 10 | 29 |
| 37. | ISJ17AE039 | SATISH KUMAR H              |    |  |  | 8  | 6 | 2 |  |  |  |    | 7  | 23 |
| 38. |            | SIDDHARTH CHANDRA CHAUDHARY |    |  |  |    |   |   |  |  |  |    | 9  | 29 |
| 39. | ISJ17AE040 |                             |    |  |  | 10 | 6 | 4 |  |  |  |    |    |    |
| 40. | ISJ17AE041 | SRIDEVI M HERLE             | 10 |  |  |    | 6 | 4 |  |  |  |    | 10 | 30 |
| 41. | ISJ17AE042 | SUBHAM                      |    |  |  |    |   |   |  |  |  |    |    |    |
| 42. | ISJ17AE043 | SUBHRA BERA                 |    |  |  | 10 |   | 4 |  |  |  |    | 8  | 22 |
|     | ISJ17AE044 | SUHAS C                     | 10 |  |  |    | 6 | 4 |  |  |  | 9  |    | 29 |

ABSENT



|     |            |                           |  |    |   |   |  |  |  |    |    |
|-----|------------|---------------------------|--|----|---|---|--|--|--|----|----|
| 43. | 1SJ17AE046 | VINEETH V                 |  | 10 | 6 | 4 |  |  |  | 10 | 30 |
| 44. | 1SJ17AE048 | NANDAN KUMAR .S           |  | 9  | 3 | 3 |  |  |  | 9  | 24 |
| 45. | 1SJ17AE049 | GURUMALLESH               |  | 6  | 4 | 4 |  |  |  | 1  | 15 |
| 46. | 1SJ16AE017 | INGALE AKASH<br>RAMESHWAR |  | 9  | 3 | 4 |  |  |  | 5  | 21 |
| 47. | 1SJ16AE046 | SURYA J S                 |  |    |   |   |  |  |  |    |    |

B.V.  
21/10/19

*(N Rajin)*  
21/10/19

PROFESSOR & HEAD  
Department of Aeronautical Engineering  
S.J.C. Institute of Technology  
CHICKBALLAPUR-562101

|| Jai Sri Gurudev ||  
**S.J.C. Institute of Technology, Chickballapur**  
**Department of Aeronautical Engineering**  
**Rubrics-II**

**Subject: Introduction to Composite Materials**

**Subject code: 17AE52**

| Sl. No. | USN        | NAME OF THE STUDENT                       | A | B | C | D | Total |
|---------|------------|---|---|---|---|---|-------|
| 1       | 1SJ17AE002 | ABHIJEET                                  | 4 | 1 | 4 | 0 | 09    |
| 2       | 1SJ17AE004 | AKASH H A                                 | 4 | 1 | 4 | 1 | 10    |
| 3       | 1SJ17AE005 | AKSHATA GUNDETI                           | 4 | 1 | 4 | 1 | 10    |
| 4       | 1SJ17AE006 | AMRUTHA R                                 | 4 | 1 | 4 | 1 | 10    |
| 5       | 1SJ17AE007 | ANISHREE P                                | A | A | A | A | A     |
| 6       | 1SJ17AE008 | ARUN KUMAR                                | A | A | A | A | A     |
| 7       | 1SJ17AE009 | AVESODDIN SIDDIQUI<br>FAHIMODDIN SIDDIQUI | 2 | 1 | 3 | 0 | 06    |
| 8       | 1SJ17AE010 | BASAVARAJU B N                            | 4 | 1 | 4 | 1 | 10    |
| 9       | 1SJ17AE011 | BHARATH B                                 | 4 | 1 | 4 | 1 | 10    |
| 10      | 1SJ17AE012 | C H LOKESH                                | 4 | 1 | 4 | 1 | 10    |
| 11      | 1SJ17AE013 | CHANDANA N                                | 4 | 1 | 4 | 1 | 10    |
| 12      | 1SJ17AE014 | ERAGOWDA H G                              | 4 | 1 | 4 | 1 | 10    |
| 13      | 1SJ17AE015 | FIRDOSE BANU                              | 4 | 1 | 4 | 1 | 10    |
| 14      | 1SJ17AE016 | JAHANAVI R                                | 4 | 1 | 4 | 1 | 10    |
| 15      | 1SJ17AE017 | JASON JEEVAN C J                          | 4 | 1 | 4 | 1 | 10    |
| 16      | 1SJ17AE018 | KOTA SHREYAS PRAKASH                      | 4 | 1 | 4 | 1 | 10    |
| 17      | 1SJ17AE019 | KUMAR S                                   | 4 | 1 | 3 | 0 | 08    |
| 18      | 1SJ17AE020 | LOCHANA B M                               | 4 | 1 | 4 | 1 | 10    |
| 19      | 1SJ17AE021 | MAGDUM ARIHANT<br>RAJGONDA                | 3 | 1 | 3 | 0 | 07    |
| 20      | 1SJ17AE022 | MAHESH D N                                | 4 | 1 | 4 | 1 | 10    |
| 21      | 1SJ17AE023 | MALATHI S                                 | 4 | 1 | 4 | 1 | 10    |
| 22      | 1SJ17AE024 | MANOJ C                                   | 4 | 1 | 4 | 1 | 10    |
| 23      | 1SJ17AE025 | MEGHA MANNIKERI                           | 4 | 1 | 4 | 1 | 10    |
| 24      | 1SJ17AE027 | MOHAN D C                                 | 4 | 1 | 4 | 0 | 09    |

|  |            |                                |   |   |   |   |    |
|--|------------|--------------------------------|---|---|---|---|----|
| 25   | 1SJ17AE028 | NETHRA J                       | 4 | 1 | 4 | 1 | 10 |
| 26   | 1SJ17AE029 | NIHAL N                        | 4 | 1 | 4 | 1 | 10 |
| 27   | 1SJ17AE030 | NIKHIL M                       | 4 | 1 | 4 | 1 | 10 |
| 28   | 1SJ17AE031 | NISHAT MOMIN                   | 4 | 1 | 4 | 0 | 09 |
| 29   | 1SJ17AE032 | PAVAN KALYAN B V               | 4 | 1 | 4 | 1 | 10 |
| 30   | 1SJ17AE033 | PRUTHVIJA P                    | 4 | 1 | 4 | 1 | 10 |
| 31   | 1SJ17AE035 | SACHINREDDY                    | 4 | 1 | 4 | 1 | 10 |
| 32   | 1SJ17AE036 | SANDEEP D                      | 4 | 1 | 4 | 1 | 10 |
| 33   | 1SJ17AE037 | SANDEEP N                      | 4 | 1 | 4 | 1 | 10 |
| 34   | 1SJ17AE039 | SATISH KUMAR H                 | 4 | 1 | 4 | 1 | 10 |
| 35   | 1SJ17AE040 | SIDDHARTH CHANDRA<br>CHOUHDARY | 4 | 1 | 4 | 1 | 10 |
| 36   | 1SJ17AE041 | SRIDEVI M HERLE                | 4 | 1 | 3 | 0 | 08 |
| 37   | 1SJ17AE042 | SUBHAM                         | 2 | 1 | 2 | 0 | 05 |
| 38   | 1SJ17AE043 | SUBHRA BERA                    | 4 | 1 | 4 | 0 | 09 |
| 39   | 1SJ17AE044 | SUHAS C                        | 4 | 1 | 4 | 1 | 10 |
| 40   | 1SJ17AE046 | VINEETH V                      | A | A | A | A | A  |
| 41   | 1SJ16AE002 | ABHILASH M                     | 4 | 1 | 4 | 1 | 10 |
| 43   | 1SJ17AE049 | GURUMALLESH                    | 3 | 1 | 3 | 0 | 07 |
| 44   | 1SJ17AE048 | NANDAN KUMAR S                 | 4 | 1 | 4 | 1 | 10 |
| <b>A = Description for the answer B = Figures or Diagrams C = Numericals and derivations<br/>D = Timely submission</b> |            |                                |   |   |   |   |    |

*Bing*  
25/12/17





Subject Title: ICM

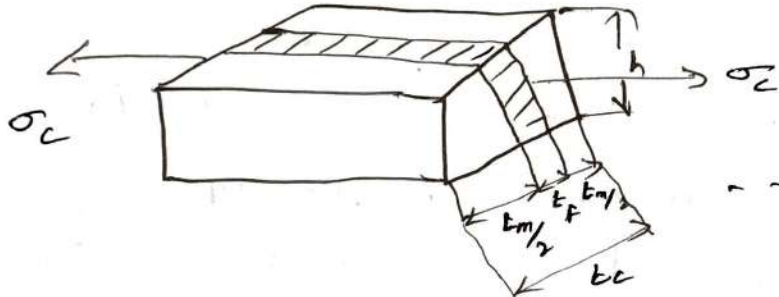
Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated   |
|-----------------|---|---|
| 2.1             | <p>(i) <u>Density of the fiber (Lamina)</u></p> $\frac{1}{\rho_c} = \frac{W_f}{\rho_f} + \frac{W_m}{\rho_m}$ $\rho_c = 2110 \text{ kg/m}^2$ <p>(ii) <u>Mass Fraction</u></p> $W_f = 0.8294$ $W_m = 0.1706$ $W_f + W_m = 1.00$ <p>(iii) <u>Volume fraction and mass of glass &amp; epoxy</u></p> $V_f = V_f \rho_c$ $= 1.327 \times 10^{-3} \text{ m}^3$ $V_m = V_m \rho_c$ $= 0.5688 \times 10^{-3} \text{ m}^3$ $w_f = \rho_f V_f$ $= 3.318 \text{ kg}$ $w_m = \rho_m V_m$ $= 0.6886 \text{ kg}$ | <p>02</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated |
|-----------------|---|-----------------|
|                 | <p>(iv) <u>Volume of Composite if the mass is H kg</u></p> $V_c = \frac{W_c}{\rho_c}$ $= 1.896 \times 10^{-3} \text{ m}^3$  | 02              |
| 2 a.)           | <p>i.) <u>Longitudinal Young's modulus (<math>E_1</math>)</u></p>  $F_c = F_f + F_m$ $E_1 E_c A_c = E_f E_f A_f + E_m E_m A_m \dots$ $E_1 = E_f V_f + E_m V_m \dots$ | 01<br>01<br>01  |
|                 | <p>(ii) <u>Transverse Young's modulus (<math>E_2</math>)</u></p> $\Delta_c = \Delta_f + \Delta_m \dots$ $E_c = \frac{\sigma_c}{E_2}$ $E_f = \frac{\sigma_f}{E_f}$   | 01              |

Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated |
|-----------------|---|-----------------|
|                 | $E_m = \frac{\sigma_m}{\epsilon_m}$ $\frac{1}{E_c} = \frac{V_f}{E_f} + \frac{V_m}{E_m} \dots \dots \dots$   | 01              |
| b.)             | <p><u>Rule of Mixture</u></p> <p>In material science, a general rule of mixture is a weighted mean used to predict various material made up of continuous and unidirectional fibers</p> <p><u>Density</u></p> $w_c = w_f + w_m$ $V_c = V_f + V_m$ <p>The density of the composite in terms of mass fractions can be found as</p> $\frac{1}{\rho_c} = \frac{w_f}{\rho_f} + \frac{w_m}{\rho_m} \dots \dots \dots$ | 02              |
|                 |   | 01              |
|                 |   | 01              |



Subject Title: ICM

Subject Code: 17AIES 2

| Question Number | Solution   | Marks Allocated   |
|-----------------|--|---|
| H a.)           | <p><u>Longitudinal Tensile Strength</u> <math>(\sigma_1^T)_{ult}</math></p> $(E_f)_{ult} = \frac{(\sigma_f)_{ult}}{E_f}$ $(E_m)_{ult} = \frac{(\sigma_m)_{ult}}{E_m}$ $(\sigma_m)_{ult} > (\sigma_f)_{ult} (v_f)_{ult} + (E_f)_{ult} E_m (1 - (v_f)_{ult})$ $\left[ (v_f)_{ult} < \frac{(\sigma_m)_{ult} - (E_f)_{ult}}{(\sigma_f)_{ult} - E_m (E_f)_{ult}} \right]$ <p><u>Longitudinal Compressive Strength</u> <math>(\sigma_1^C)_{ult}</math></p> $(E_f) = \frac{ \sigma_1^C }{E_1}$ $(\sigma_1^C) = \frac{E_1 (E_2^T)_{ult}}{v_{12}}$ $(E_{12})_{ult} = (E_f)_{ult} v_f + (E_m)_{ult} v_m$ $(\sigma_1^C)_{ult} = 2 \left[ (E_f)_{ult} v_f + (E_m)_{ult} v_m \right]$ | <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> <p>01</p> |



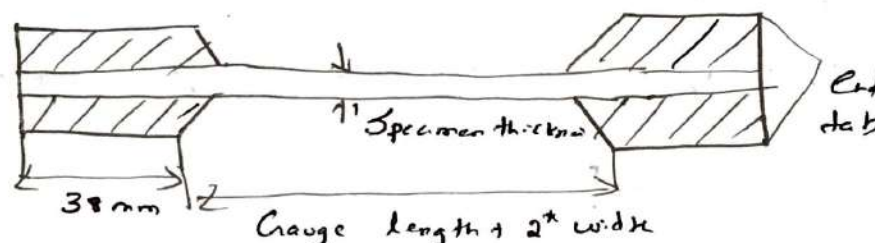
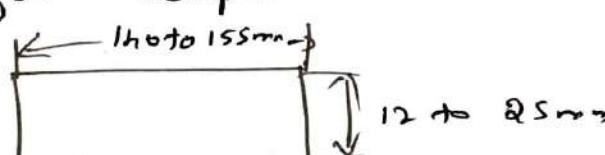
Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
| b.)             | <p><u>Micromechanics</u></p> <p>Micromechanics is the analysis of composite of heterogeneous materials on the level of the individual constituents that constitute these materials.</p> <p><u>Macromechanics</u></p> <p>The study of composite material behaviour when the material <del>but</del> is homogeneous and the effect of constituent materials are detected only as averaged apparent properties of the composite material.</p> | 02<br><br>02    |
| 5.1             | <p><u>Destructive Methods</u></p> <p>i.) <u>Tensile</u></p> <p>The tensile properties laminate are determined in accordance with ASTM D3039</p>  | 01              |

Subject Title: IEM

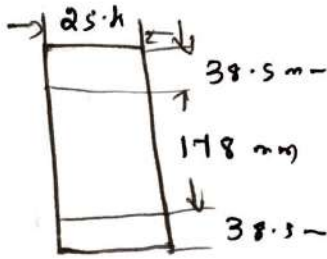
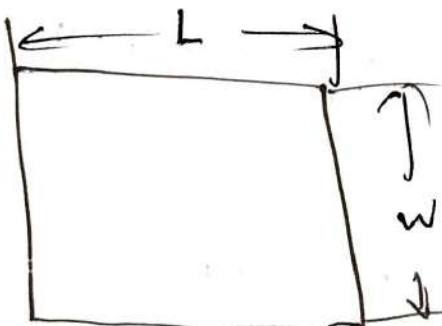
Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
|                 |    | 02              |
|                 | <p style="text-align: center;"><u>Explanation</u></p> <p>(ii) <u>Compression</u></p> <p>The method determines In-plane Compressive Properties by applying the Compressive force into the specimen at wedge grip interface. ASTM D3410 is most appropriate for Composite materials</p>  | 01              |
|                 | <p style="text-align: center;"><u>Explanation</u></p> <p>(iii) <u>Shear</u></p> <p>The Shear modulus <math>G_{12}</math> and the Ultimate Shear Strength (<math>T_{12}</math>) of uni-directional fiber reinforced Composite may be determined by any of the below follow-</p>   | 01              |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated               |
|-----------------|--|-------------------------------|
|                 | <p>1.) <math>\pm 45^\circ</math> (ASTM D 3518)</p> <p>(ii) V-notch Shear test (ASTM D 5379)</p>  <p style="text-align: center;"><u>Explanation</u></p>  | <p>01</p> <p>01</p> <p>01</p> |
| <p>6.)</p>      | <p>1.) <u>Hardness Testing</u></p> <p>R and M Scales are used for Plastics. The Hardness is read directly from the dial with either R, L, M, K or E Scales</p>  <p>3 methods,</p> <ul style="list-style-type: none"> <li>1.) <u>Brenell</u></li> <li>ii) <u>Rockwell</u></li> <li>iii) <u>Vicker's</u></li> </ul> | <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: MAES2

| Question Number | Solution  | Marks Allocated                         |
|-----------------|---|---|
|                 | <p>(ii) <u>Ultrasonic Inspection</u></p> <p>Ultrasonic inspection is another type of NDT, which is used for inspection of composite material, 3 types</p> <ul style="list-style-type: none"> <li>i.) A - Scan</li> <li>(ii) C - Scan</li> <li>c.) AND Scan</li> </ul> <p>(i) <u>A - Scan</u></p> <ul style="list-style-type: none"> <li>(*) Uses Pulse-echo system to locate the flaws</li> <li>(*) User needs to know the velocity</li> </ul> <p>(ii) <u>C - Scan</u></p> <ul style="list-style-type: none"> <li>(*) It measures the amount of time that sound passes through thickness of material</li> <li>(*) Provides good overall scan image</li> </ul> | <p>01</p> <p>01</p> <p>01</p> <p>01</p> |




Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated               |
|-----------------|--|-------------------------------|
|                 | <p>(iii) <u>AND-Scan</u></p> <p>(* A Mechanical arm is attached to the Transducer, Connected to Computer.</p> <p><u>Applications of Composites</u></p> <p>i.) <u>Aircraft</u><br/>Rotor blades, Fins, Rudder, Wing body fuel tank, Propeller blades, Radomes, Fairings, Engine Cowling etc</p> <p>ii) <u>Space</u><br/>Rocket motor casing, fans &amp; blades, Condenser shells, Valves &amp; Strainers, gear cases, Small boats, hulls etc</p> <p><u>Staff Incharge</u><br/>12/10/19</p> <p><u>Reviewer</u><br/>14/11/19</p> <p><u>HOD</u><br/>14/10/19</p> | <p>01</p> <p>01</p> <p>01</p> |

**Internal Test Question paper**Name of the staff/s: **BINO PRINCE RAJA.D**

Date: 11/10/2019

Signature: 

Reviewer's Signature:

**S.J.C. Institute of Technology  
Department of Aeronautical Engineering****Test: II****Semester: V****Subject Name & Code: Introduction to Composite Materials - 17AE52**

Duration: 90 Minutes

Max Marks: 30

**NOTE:** 1. Answer all three main questions, choosing one full question from each main

2. Missing data if any, can be suitably assumed

| Question Number |   | Marks | CO  | Levels |
|-----------------|---|-------|-----|--------|
| 1               | A Glass/Epoxy lamina with 70% fiber volume fractions has the following fiber and matrix properties. $E_f=85$ GPa, $E_m=3.4$ GPa, $\nu_f=0.2$ , $\nu_m=0.2$ . Find out the following<br>i) Longitudinal young's modulus<br>ii) Transverse young's modulus<br>iii) In-Plane shear modulus<br>iv) Major and minor Poisson's ratio                              | 10    | CO3 | L-3    |
| <b>OR</b>       |   |       |     |        |
| 2               | A glass/epoxy lamina consists of a 70% fiber volume fraction. Assume the Density of fiber and matrix a $\rho_f=2500\text{kg/m}^3$ and $\rho_m=1200\text{kg/m}^3$ . Determine the i). Density of lamina ii). Mass fraction of the glass and epoxy iii). Volume of composite lamina if the mass of the lamina is 4kg iv). Volume and mass of glass and epoxy. | 10    | CO3 | L-3    |
| 3               | a. Evaluate $E_1$ and $E_2$ by the rule of mixture.   | 06    | CO3 | L-3    |
|                 | b. Define the term rule of mixture. Obtain the relationship for density of composite using rule of mixture.   | 04    | CO3 | L-3    |
| <b>OR</b>       |   |       |     |        |

**//JAI SRI GURUDEV//**  
**S.J.C INSTITUTE OF TECHNOLOGY**  
**DEPARTMENT OF AERONAUTICAL ENGINEERING**  
**Introduction to Composite Materials (17AE52)**  
**Tutorials-II**

| Sl. No.           | Questions  | CO  | Levels |
|-------------------|--|-----|--------|
| <b>MODULE-III</b> |  |     |        |
| 1.                | A Glass/Epoxy lamina with 70% fiber volume fractions has the following fiber and matrix ,properties.<br>$E_f=85$ GPa, $E_m=3.4$ GPa, $\nu_f=0.2$ , $\nu_m=0.2$ .<br>Find out the following<br>i) Longitudinal young's modulus<br>ii) Transverse young's modulus<br>iii) In-Plane shear modulus<br>iv) Major and minor Poisson's ratio                      | CO3 | L-3    |
| 2.                | Define the term rule of mixture. Obtain the relationship for density of composite using rule of mixture.   | CO3 | L-3    |
| 3.                | Define the term rule of mixture. Obtain the relationship for Volume of composite using rule of mixture.  | CO3 | L-3    |
| 4.                | Define the term rule of mixture. Obtain the relationship for Voids of composite using rule of mixture.   | CO3 | L-3    |
| 5.                | A glass/epoxy lamina consists of a 70% fiber volume fraction. Assume the Density of fiber and matrix $\rho_f= 2500\text{kg/m}^3$ and $\rho_m= 1200\text{kg/m}^3$ .Determine the i). Density of lamina ii). Mass fraction of the glass and epoxy iii). Volume of composite lamina if the mass of the lamina is 4kg iv). Volume and mass of glass and epoxy. | CO3 | L-3    |
| 6.                | Evaluate $E_1$ and $E_2$ by the rule of mixture.   | CO3 | L-3    |
| 7.                | Evaluate $\nu_{12}$ and $G_{12}$ by the rule of mixture.   | CO3 | L-3    |
| 8.                | Distinguish between micromechanics and macromechanics.   | CO3 | L-3    |
| 9.                | Explain about the experimental determination of material constants<br>i) Longitudinal Tensile Strength<br>ii) Longitudinal Compressive strength  | CO3 | L-3    |
| 10.               | Explain about the experimental determination of material constants<br>i) Transverse Tensile Strength   | CO3 | L-3    |

|                 |   |     |      |
|-----------------|---|-----|------|
|                 | ii) Transverse Compressive strength<br>iii) In-Plane shear strength   |     |      |
| <b>MODULE-V</b> |   |     | L-3- |
| 11.             | List the NDT methods are normally used for testing FRP  | CO5 | L-3  |
| 12.             | Explain the following inspection and quality control methods<br>i) Hardness testing<br>ii) Ultrasonic inspection                      | CO5 | L-3  |
| 13.             | Explain about the ultrasonic testing of A and C scan.   | CO5 | L-3  |
| 14.             | Explain the destructive testing methods with suitable diagrams<br>i) Flexural<br>ii) Shear  | CO5 | L-3  |
| 15.             | Explain the destructive testing methods with suitable diagrams<br>i) Tensile<br>ii) Compression                                       | CO5 | L-3  |
| 16.             | Discuss the future potential of composites  | CO5 | L-3  |
| 17.             | Write short notes on the application of composites in the following industries<br>i) Aircraft ii) Automobile iii) Missiles            | CO5 | L-3  |
| 18.             | Write short notes on the application of composites in the following industries<br>i) Space hardware ii) Marine iii) Sports equipments | CO5 | L-3  |

*Raj*  
15/10/19

*(V Rajan)*  
15/10/19



Name of the staff: Dr. BINO PRINCE RAJA.D

Subject: Introduction to composite materials

Sub code: 17AE52

Semester: V

Mapping of CO matrix with Test- Question Papers

(IA-3)

| Sl.No | USN        | CO's      | Name                                    | CO | CO | CO | CO | CO | CO | CO | CO | CO | CO | Total Marks | Total Marks |
|-------|------------|-----------|---|----|----|----|----|----|----|----|----|----|----|-------------|-------------|
|       |            |           |   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |             |             |
|       |            | Max Marks |   | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 100         | 30          |
|       |            | Q.No      |   | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 |             |             |
| 1.    | 1SJ16AE002 |           | Abhilash .M                             | 20 |    |    | 14 |    | 17 |    | 18 |    | 20 | 90          | 27          |
| 2.    | 1SJ16AE011 |           | ChavanDatta                             |    |    |    |    |    |    |    |    |    |    |             |             |
| 3.    | 1SJ16AE039 |           | Sanjay M                                |    |    |    |    |    |    |    |    |    |    |             |             |
| 4.    | 1SJ17AE002 |           | Abhijeet                                |    | 20 |    | 20 | 20 |    |    | 20 | 20 |    | 100         | 30          |
| 5.    | 1SJ17AE004 |           | Akash H A                               | 20 |    | 20 |    | 20 |    |    | 20 | 20 |    | 100         | 30          |
| 6.    | 1SJ17AE005 |           | AkshataGundet                           | 20 |    |    | 17 | 17 |    |    | 20 | 20 |    | 94          | 29          |
| 7.    | 1SJ17AE006 |           | Amrutha R                               | 20 |    | 20 |    | 20 |    |    | 20 | 20 |    | 100         | 30          |
| 8.    | 1SJ17AE007 |           | Anishree P                              |    |    |    |    |    |    |    |    |    |    |             |             |
| 9.    | 1SJ17AE008 |           | Arun Kumar                              |    |    |    |    |    |    |    |    |    |    |             |             |
| 10.   | 1SJ17AE009 |           | AvesoddinSiddiquiFahi<br>moddinSiddiqui | 16 |    | 20 |    | 15 |    |    | 20 | 20 |    | 91          | 28          |
| 11.   | 1SJ17AE010 |           | Basavaraju B N                          |    | 20 | 20 |    | 20 |    |    | 20 | 20 |    | 100         | 30          |
| 12.   | 1SJ17AE011 |           | Bharath B                               |    | 20 | 19 |    | 20 |    |    | 20 | 20 |    | 99          | 30          |
| 13.   | 1SJ17AE012 |           | C H Lokesh                              |    | 20 | 20 |    | 18 |    |    | 20 | 20 |    | 98          | 30          |
| 14.   | 1SJ17AE013 |           | Chandana N                              |    | 20 |    | 20 | 20 |    |    | 20 | 20 |    | 100         | 30          |
| 15.   | 1SJ17AE014 |           | Eragowda H G                            | 20 |    | 19 |    | 17 |    |    | 20 | 20 |    | 96          | 29          |
| 16.   | 1SJ17AE015 |           | FirdoseBanu                             | 20 |    | 20 |    | 10 |    |    | 20 | 18 |    | 98          | 30          |
| 17.   | 1SJ17AE016 |           | Jahanavi R                              | 20 |    |    | 20 | 20 |    |    | 20 | 20 | 20 | 100         | 30          |
| 18.   | 1SJ17AE017 |           | Jason Jeevan C J                        | 10 |    |    | 10 | 20 |    |    | 18 | 15 |    | 73          | 22          |
| 19.   | 1SJ17AE018 |           | Kota ShreyasPrakash                     |    | 20 | 20 |    |    | 15 |    | 20 | 18 |    | 93          | 28          |



|| Jai Sri Gurudev ||  
**S.J.C. Institute of Technology, Chickballapur**  
**Department of Aeronautical Engineering**  
**Rubrics-III**

**Subject: Introduction to Composite Materials**

**Subject code: 17AE52**

| Sl. No. | USN        | NAME OF THE STUDENT                       | A | B | C | D | Total |
|---------|------------|---|---|---|---|---|-------|
| 1       | 1SJ17AE002 | ABHIJEET                                  | 4 | 1 | 4 | 1 | 10    |
| 2       | 1SJ17AE004 | AKASH H A                                 | 4 | 1 | 4 | 1 | 10    |
| 3       | 1SJ17AE005 | AKSHATA GUNDETI                           | 4 | 1 | 4 | 1 | 09    |
| 4       | 1SJ17AE006 | AMRUTHA R                                 | 4 | 1 | 4 | 1 | 10    |
| 5       | 1SJ17AE007 | ANISHREE P                                | A | A | A | A | A     |
| 6       | 1SJ17AE008 | ARUN KUMAR                                | A | A | A | A | A     |
| 7       | 1SJ17AE009 | AVESODDIN SIDDIQUI<br>FAHIMODDIN SIDDIQUI | 4 | 1 | 4 | 0 | 09    |
| 8       | 1SJ17AE010 | BASAVARAJU B N                            | 4 | 1 | 4 | 1 | 10    |
| 9       | 1SJ17AE011 | BHARATH B                                 | 4 | 1 | 4 | 1 | 10    |
| 10      | 1SJ17AE012 | C H LOKESH                                | 4 | 1 | 4 | 1 | 10    |
| 11      | 1SJ17AE013 | CHANDANA N                                | 4 | 1 | 4 | 1 | 10    |
| 12      | 1SJ17AE014 | ERAGOWDA H G                              | 4 | 1 | 4 | 1 | 10    |
| 13      | 1SJ17AE015 | FIRDOSE BANU                              | 4 | 1 | 4 | 1 | 10    |
| 14      | 1SJ17AE016 | JAHANAVI R                                | 4 | 1 | 4 | 0 | 09    |
| 15      | 1SJ17AE017 | JASON JEEVAN C J                          | 4 | 1 | 4 | 1 | 10    |
| 16      | 1SJ17AE018 | KOTA SHREYAS PRAKASH                      | 4 | 1 | 4 | 1 | 10    |
| 17      | 1SJ17AE019 | KUMAR S                                   | 4 | 1 | 4 | 1 | 10    |
| 18      | 1SJ17AE020 | LOCHANA B M                               | 4 | 1 | 4 | 1 | 10    |
| 19      | 1SJ17AE021 | MAGDUM ARIHANT<br>RAJGONDA                | 4 | 1 | 4 | 0 | 09    |
| 20      | 1SJ17AE022 | MAHESH D N                                | 4 | 1 | 4 | 1 | 10    |
| 21      | 1SJ17AE023 | MALATHI S                                 | 4 | 1 | 4 | 1 | 10    |
| 22      | 1SJ17AE024 | MANOJ C                                   | 4 | 1 | 4 | 1 | 10    |
| 23      | 1SJ17AE025 | MEGHA MANNIKERI                           | 4 | 1 | 4 | 1 | 10    |
| 24      | 1SJ17AE027 | MOHAN D C                                 | 4 | 1 | 4 | 1 | 10    |

//JAI SRI GURUDEV//  
**S.J.C INSTITUTE OF TECHNOLOGY**  
**DEPARTMENT OF AERONAUTICAL ENGINEERING**  
**Introduction to Composite Materials (17AE52)**  
**Tutorials-III**

| Sl. No.          | Questions  | CO  | Levels |
|------------------|--|-----|--------|
| <b>MODULE-IV</b> |  |     |        |
| 1.               | What is Failure theory and write the salient points on Need of failure theory.   | CO4 | L-3    |
| 2.               | Explain the following with suitable derivation<br>i) Maximum stress criteria<br>ii) Maximum strain criteria  | CO4 | L-3    |
| 3.               | Explain the following with suitable derivation<br>i) Tsai-hill theory<br>ii) Tsai-wu theory  | CO4 | L-3    |
| 4.               | For a failure analysis of a uni-directional lamina subjected to a 2D plane stress state and expresses in equation form the<br>i) Maximum stress criteria                      ii) Tsai-Hill criteria<br>iii) Tsai-wu criteria  | CO4 | L-3    |
| 5.               | A tensile specimen of a unidirectional composite is prepared such that the fibers make an angle of $5^\circ$ with the applied load. Determine the stress to cause failure according to<br>i) The maximum stress criterion<br>ii) The maximum strain criterion<br>The following properties may be used $E_1=76$ GPa, $E_2=5.5$ GPa, $G_{12}=2.35$ GPa, $Y_{12}=0.33$ , $\sigma_{11}=1250$ MPa, $\sigma_{21}=30$ MPa, $\tau_{12}=50$ MPa, $\sigma_{1C}=1000$ MPa, $\sigma_{2C}=100$ MPa. | CO4 | L-3    |
| 6.               | Compute [A] [B] and [D] matrices for a $[0/90^\circ]$ laminate with the following properties thickness of each lamina is 0.125mm. $E_1=140$ GPa, $E_2=10$ GPa. $Y_{12}=0.3$ , $G_1=5$ GPa.   | CO4 | L-3    |
| 7.               | Explain CLT and derive expression for A,B and D matrices for laminate.   | CO4 | L-3    |
| 8.               | Explain macro-mechanical failure theories and explain any one in detail  | CO4 | L-2    |
| 9.               | Derive an relationship for stress strain for 2-D plane stress in an orthotropic material.  | CO4 | L-3    |
| 10.              | Derive the expression for resultant laminate force and momentum using classical laminate theory.   |     |        |



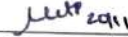
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| <b>Internal Test Question paper</b> |
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| Name of the staff/s: <b>Dr. BINO PRINCE RAJA.D</b> |
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| Date: 18/11/2019 |
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| Signature:  |
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| Reviewer's Signature: |
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**S.J.C. Institute of Technology**  
**Department of Aeronautical Engineering**  
**Test: III**  
**Semester: V**

**Subject Name & Code: Introduction to Composite Materials - 17AE52**

Duration: 3 Hours

Max Marks: 100

**NOTE:** 1. Answer all the main questions, choosing one full question from each main

2. Missing data if any, can be suitably assumed

| Question Number |  | Marks | CO  | Levels |
|-----------------|--|-------|-----|--------|
| 1               | a) Define Composite materials. How are they classified? Explain in detail  | 10    | CO1 | L-2    |
|                 | b) Distinguish between thermoplastics and thermosets.  | 06    | CO1 | L-2    |
|                 | c) Write a short note on whiskers and flakes.  | 04    | CO1 | L-2    |
| <b>OR</b>       |  |       |     |        |
| 2               | a) Define PMC. Explain briefly about its classification, advantages and Dis-advantages.  | 12    | CO1 | L-2    |
|                 | b) Explain about Carbon-Carbon composites. Mention its advantages, dis-advantages and applications.  | 08    | CO1 | L-2    |
| 3               | Briefly explain the following techniques of processing composites and list the merits and demerits.<br>i) Pultrusion<br>ii) Filament Winding | 20    | CO2 | L-2    |
| <b>OR</b>       |  |       |     |        |



|    |   |    |     |     |
|----|---|----|-----|-----|
| 4  | Discuss the following techniques of processing composites and list the merits and demerits<br>i) Extrusion Process<br>ii) Injection Moulding process<br>iii)  | 20 | CO2 | L-2 |
| 5  | a. Evaluate $E_1$ and $E_2$ by the rule of mixture.   | 10 | C03 | L-3 |
|    | b. A glass/epoxy lamina consists of a 70% fiber volume fraction. Assume the Density of fiber and matrix a $\rho_f = 2500\text{kg/m}^3$ and $\rho_m = 1200\text{kg/m}^3$ . Determine the i). Density of lamina<br>ii). Mass fraction of the glass and epoxy<br>iii). Volume of composite lamina if the mass of the lamina is 4kg<br>iv). Volume and mass of glass and epoxy. | 10 | C03 | L-3 |
| OR |   |    |     |     |
| 6  | a) For a unidirectional lamina in a 2D plane stress state. Derive reduced stiffness matrix and express these matrix coefficient in terms of engineering elastic constants   | 10 | C03 | L-3 |
|    | b) Find reduced stiffness matrix for a unidirectional lamina . use elastic constants $E_1=150\text{ GPa}$ , $E_2=320\text{ GPa}$ , $\nu_{12}=0.2$ , $G_{12}=5\text{ GPa}$   | 10 | C03 | L-3 |
| 7  | Explain the following with suitable derivation<br>i) Tsai-hill theory<br>ii) Tsai-wu theory<br>iii) Maximum stress criteria   | 20 | C04 | L-3 |
| OR |   |    |     |     |
| 8  | Derive the expression for the below mentioned composite laminate theory<br>i) Classical laminate theory<br>ii) $[A][B][D]$ matrix   | 20 | C04 | L-3 |
| 9  | Explain in detail about the destructive and nondestructive methods of composites with neat sketches.  | 20 | C05 | L-2 |
| OR |   |    |     |     |
| 10 | Write a short note on the application of composites in the following industries<br>i) Aircraft ii) Automobile iii) Missiles<br>iv) Marine v) Space Hardware   | 20 | C05 | L-2 |

**COURSE OUTCOMES:**

**On successful completion of this course, students should be able to**

|     |   |
|-----|---|
| CO1 | Understand the concept of composite materials over monolithic materials, as well as some basic knowledge about constituents of composite materials (L2) |
| CO2 | Study the different fabrication techniques used to investigate the PMC, CMC and MMC composites (L2)   |
| CO3 | Analyze the problems on micro-mechanical and macro-mechanical behavior of lamina (L3)   |
| CO4 | Predict the failure strength of a laminated composite plate and identify the suitable machining method for a given type of laminate (L3)                |
| CO5 | Examine the failure analysis using Destructive and Non Destructive testing, and find suitable applications.(L3)   |



**DEPARTMENT: AERONAUTICAL ENGINEERING**

**Scheme & Solutions- TEST- I/II/III**

Date: 21/11/19

Semester: V

Subject Title: Introduction to Composite Materials Subject Code: 17AES2

| Question Number                                | Solution  | Marks Allocated               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
|--|---|-------------------------------|----------------------|---|----------------------------------|--|--------------------------|----------------------|----------------------------------|-------------------------|----------------------------|---------------------------|-------------------------|-------------------------------|
| 1 a.)  | <p><u>Composite Materials</u></p> <p>A Composite materials can be defined as a combination of two or more constituent materials with different physical or chemical properties. 2 types</p> <p>i.) Matrix . . . . . <u>Explanation</u> . . . . .</p> <p>(ii) Reinforcement . . . . . <u>Explanation</u> . . . . .</p>   | <p>02</p> <p>04</p> <p>04</p> |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| b.)  | <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;"><u>Thermoplastics</u></td> <td style="width: 50%;"><u>Thermosetting</u></td> </tr> <tr> <td>i.) Soften on heating, harden when cooled</td> <td>i.) They become permanently hard</td> </tr> <tr> <td>(ii) Semi-crystalline &amp; amorphous in structure</td> <td>(ii) Amorphous structure</td> </tr> <tr> <td>(iii) Soft &amp; Ductile</td> <td>(iii) Harder, Stronger &amp; Brittle</td> </tr> <tr> <td>(iv) can be reprocessed</td> <td>(iv) Cannot be reprocessed</td> </tr> <tr> <td>(v) Indefinite shelf life</td> <td>(v) Definite shelf life</td> </tr> </table> | <u>Thermoplastics</u>         | <u>Thermosetting</u> | i.) Soften on heating, harden when cooled | i.) They become permanently hard | (ii) Semi-crystalline & amorphous in structure | (ii) Amorphous structure | (iii) Soft & Ductile | (iii) Harder, Stronger & Brittle | (iv) can be reprocessed | (iv) Cannot be reprocessed | (v) Indefinite shelf life | (v) Definite shelf life | <p>02</p> <p>02</p> <p>02</p> |
| <u>Thermoplastics</u>                          | <u>Thermosetting</u>  |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| i.) Soften on heating, harden when cooled      | i.) They become permanently hard  |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| (ii) Semi-crystalline & amorphous in structure | (ii) Amorphous structure  |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| (iii) Soft & Ductile                           | (iii) Harder, Stronger & Brittle  |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| (iv) can be reprocessed                        | (iv) Cannot be reprocessed  |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| (v) Indefinite shelf life                      | (v) Definite shelf life   |                               |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |
| c.)  | <p><u>Whiskers and Flakes</u></p> <p>Whisker are monocrystalline, short fibre with extremely high strength. This is because of the absence of crystalline imperfections such as dislocations.</p> <p>Flakes are small, flat, very thin piece of something, typically one which has broken away or been peeled off by larger piece.</p>  | <p>02</p> <p>02</p>           |                      |   |                                  |  |                          |                      |                                  |                         |                            |                           |                         |                               |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated                                   |
|-----------------|---|---|
| 2 a.)           | <p><u>PMC</u></p> <p>If the matrix is made from polymer resin material, then it is said to be PMC.</p> <p>2 types</p> <p>i.) Thermoplastic</p> <p>(ii) Thermosetting</p> <p><u>Advan</u></p> <p>(*) low cost</p> <p>(*) low density</p> <p><u>Dis-Adv</u></p> <p>(*) low strength</p> <p>(*) low modulus</p> <p><u>Appln</u></p> <p>(*) Aerospace</p>   | <p>02</p> <p>02</p> <p>02</p> <p>02</p> <p>02</p> |
| b.)             | <p><u>Carbon - Carbon Composites (C-C)</u></p> <p>C-C Composites are structures in which both the matrix and reinforcement are made of carbon only.</p> <p><u>Adv</u></p> <p>(*) Density is 1.5 to 2.0 g/cc</p> <p>(*) Temperature withstanding capacity of 2200°C</p> <p><u>Dis-Adv</u></p> <p>(*) Lack of Oxidation Resistance</p> <p><u>Appln</u></p> <p>(*) Military &amp; Aerospace requirements</p> <p>(*) Heat Shields</p> | <p>02</p> <p>02</p> <p>02</p> <p>02</p>           |
| 3.)             | <p><u>Pultrusion</u></p> <p>In this process continuous sections of polymer matrix composites with fibers oriented mainly axially produced</p>   | <p>02</p>   |



Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution  | Marks Allocated |
|-----------------|---|-----------------|
|                 | <u>Diagram</u> . . . . .  | 02              |
|                 | <u>Advant</u><br>(+) Automated Process<br>(+) Low waste   | 02              |
|                 | <u>Dis-Adv</u><br>(*) High Investment cost<br>(+) long tooling time   | 02              |
|                 | <u>Appln</u><br>(*) I-beams, Channels, tubes  | 02              |
|                 | <u>Filament Winding</u><br>It is a Venable technique in which continuous tow (or) rod is passed through a resin impregnation bath and wood over a rotating or stationary mandrel. | 02              |
|                 | <u>Diagram</u> . . . . .  | 02              |
|                 | <u>Advan</u><br>(*) Excellent Mechanical Property<br>(+) High strength to wt ratio  |                 |
|                 | <u>Dis-Adv</u><br>(+) High Cost<br>(+) only smooth surface can be obtained  |                 |
|                 | <u>Appln</u><br>(+) Storage tanks, Pipelines<br>(*) Gas cylinders etc   |                 |

Subject Title: ICM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
| 4               | <p>i.) <u>Extnsion Process</u></p> <p>Extnsion is the same process alike Pultusion. Here the material will be pushed to get a required shape.</p> <p>Diagram . . . . . 02<br/>           Process . . . . . 02<br/>           Adv &amp; Dis-Adv . . . . . 02<br/>           Appln . . . . . 02</p> <p><u>Injection Moulding Process</u></p> <p>In this process, molten polymer is mixed with very short fibers &amp; injected under high pressure into a mould cavity having the desired shape of component.</p> <p>Diagram . . . . . 02<br/>           Process . . . . . 02<br/>           Adv &amp; Dis-Adv . . . . . 02<br/>           Apph . . . . . 02</p> | 02              |
| 5 a.)           | <p><u>Longitudinal modulus (E<sub>l</sub>)</u></p> $F_c = F_f + F_m \dots \dots \dots$ $E_l E_c A_c = E_f E_f A_f + E_m E_m A_m \dots \dots \dots$ $E_l = E_f V_f + E_m V_m \dots \dots \dots$   | 02<br>01<br>02  |

Subject Title: CM

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated                         |
|-----------------|--|---|
|                 | <p><u>Transverse Young's modulus (<math>E_2</math>)</u></p> $\Delta_c = \Delta_f + \Delta_m \dots \dots \dots$ $E_c = \frac{\sigma_c}{\epsilon_c}$ $E_f = \frac{\sigma_f}{\epsilon_f}$ $E_m = \frac{\sigma_m}{\epsilon_m}$ | <p>02</p> <p>01</p>                     |
| b.)             | <p>i.) <u>Density</u></p> $\frac{1}{\rho_c} = \frac{W_f}{\rho_f} + \frac{W_m}{\rho_m}$ $\rho_c = 2110 \text{ kg/m}^3$  | <p>02</p> <p>01</p> <p>02</p>           |
|                 | <p>(ii) <u>Mass fraction</u></p> $W_f = 0.8294$ $W_m = 0.1706$ $W_f + W_m = 1.00$  | <p>01</p> <p>01</p> <p>01</p>           |
|                 | <p>(ii) <u>Volume fraction &amp; mass of glass &amp; epoxy</u></p> $V_f = 1.327 \times 10^{-3} \text{ m}^3$ $V_m = 0.5688 \times 10^{-3} \text{ m}^3$ $W_f = 3.318 \text{ kg}$ $W_m = 0.6826$                              | <p>01</p> <p>01</p> <p>01</p> <p>01</p> |



Subject Title: ICM

Subject Code: 17A ES3

| Question Number | Solution  | Marks Allocated                                   |
|-----------------|---|---|
| 6 a.)           | <p><u>Reduced Stiffness Matrix</u></p> <p>A Unidirectional lamina falls under the Orthotropic material category -</p> <p>Assuming <math>\sigma_3 = 0</math>, <math>\tau_{23} = 0</math>, <math>\tau_{31} = 0</math></p> $E_3 = S_{13} \sigma_1 + S_{23} \sigma_2$ $\begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \gamma_{12} \end{bmatrix} = \begin{bmatrix} S_{11} & S_{12} & 0 \\ S_{12} & S_{22} & 0 \\ 0 & 0 & S_{66} \end{bmatrix} \begin{bmatrix} \sigma_1 \\ \sigma_2 \\ \tau_{12} \end{bmatrix}$ $\begin{bmatrix} \sigma_1 \\ \sigma_2 \\ \tau_{12} \end{bmatrix} = \begin{bmatrix} Q_{11} & Q_{12} & 0 \\ Q_{12} & Q_{22} & 0 \\ 0 & 0 & Q_{66} \end{bmatrix} \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \gamma_{12} \end{bmatrix}$ <p>The above eqn is reduced stiffness matrix.</p> | <p>01</p> <p>02</p> <p>02</p> <p>02</p> <p>03</p> |
| b.)             | <p>The reduced stiffness matrix <math>[Q]</math> elements are:</p> $Q_{11} = 181.8 \times 10^9 \text{ Pa}$ $Q_{12} = 2.897 \times 10^9 \text{ Pa}$ $Q_{22} = 10.3 \times 10^9 \text{ Pa}$ $Q_{66} = 7.17 \times 10^9 \text{ Pa}$ $[Q] = \begin{bmatrix} 181.8 \times 10^9 & 2.897 \times 10^9 & 0 \\ 2.897 \times 10^9 & 10.3 \times 10^9 & 0 \\ 0 & 0 & 7.17 \times 10^9 \end{bmatrix} \text{ Pa}$   | <p>02</p> <p>02</p> <p>02</p> <p>02</p> <p>02</p> |





Subject Title: ICM

| Question Number | Solution  | Marks Allocated   |
|-----------------|---|---|
| 8.)             | <p>1.) <u>Classical laminate theory (CLT)</u></p> <p>CLT is a simple analysis through which the forces acting on a laminate are related to the mid-plane strains and curvatures.</p> $u = u_0 - z\alpha$ $\epsilon_x = \frac{\partial u_0}{\partial x} - z \frac{\partial^2 w_0}{\partial x^2}$ $\epsilon_y = \frac{\partial v_0}{\partial y} - z \frac{\partial^2 w_0}{\partial y^2}$ $\gamma_{xy} = \frac{\partial u_0}{\partial y} + \frac{\partial v_0}{\partial x} - 2z \frac{\partial^2 w_0}{\partial x \partial y}$ $\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} Q_{11} & Q_{12} & Q_{16} \\ Q_{12} & Q_{22} & Q_{26} \\ Q_{16} & Q_{26} & Q_{66} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix} + z \dots$ <p><u>[A][B][D] Matrix</u></p> $N_x = \int_{-h/2}^{h/2} \sigma_x dz, \quad N_y = \int_{-h/2}^{h/2} \sigma_y dz, \quad N_{xy} = \int_{-h/2}^{h/2} \tau_{xy} dz$ $[A] = \sum_{k=1}^n [Q_{ij}]^k [z_k - z_{k-1}] = \begin{bmatrix} A_{11} & A_{12} & A_{16} \\ A_{12} & A_{22} & A_{26} \\ A_{16} & A_{26} & A_{66} \end{bmatrix}$ $[B] = \sum_{k=1}^n [Q_{ij}]^k [z_k^2 - z_{k-1}^2] = \begin{bmatrix} B_{11} & B_{12} & B_{16} \\ B_{12} & B_{22} & B_{26} \\ B_{16} & B_{26} & B_{66} \end{bmatrix}$ $[D] = \sum_{k=1}^n [Q_{ij}]^k [z_k^3 - z_{k-1}^3] = \begin{bmatrix} D_{11} & D_{12} & D_{16} \\ D_{12} & D_{22} & D_{26} \\ D_{16} & D_{26} & D_{66} \end{bmatrix}$ | <p>01</p> <p>02</p> <p>02</p> <p>02</p> <p>01</p> <p>02</p> <p>03</p> <p>03</p> <p>02</p> <p>02</p> |

Subject Title: Icm

Subject Code: 17AES2

| Question Number | Solution   | Marks Allocated  |
|-----------------|--|--|
| 9.)             | <p><u>Destructive Testing</u></p> <ul style="list-style-type: none"> <li>i.) Tensile</li> <li>(ii) Flexural</li> <li>(iii) Compression</li> <li>(iv) Hardness</li> <li>(v) Shear</li> </ul> <p style="margin-left: 400px;">Explanation</p> <p><u>Non-Destructive Testing</u></p> <ul style="list-style-type: none"> <li>i.) Ultrasonic testing           <ul style="list-style-type: none"> <li>A-scan</li> <li>B-scan</li> <li>AND scan</li> </ul> </li> <li>Explanation</li> </ul> | <p>02</p> <p>02</p> <p>02</p> <p>02</p> <p>02</p><br><p>03</p> <p>03</p> <p>02</p> <p>02</p> |
| 10.)            | <p><u>Applications of Composites</u></p> <ul style="list-style-type: none"> <li>i.) <u>Aircraft</u> <ul style="list-style-type: none"> <li>Rotor blades, Fins, Rudder,</li> <li>Wing body, fuel tank, Propeller,</li> <li>Radome</li> </ul> </li> <li>(ii) <u>Automobile</u> <ul style="list-style-type: none"> <li>Roof rail, Bumper, hand doors,</li> <li>doors etc</li> </ul> </li> </ul>   | <p>04</p> <p>04</p>  |



Subject Title: Icm

Subject Code: 17AE52

| Question Number | Solution   | Marks Allocated |
|-----------------|--|-----------------|
|                 | <p>(iii) <u>Missiles</u></p> <p>(*) Rocket motor casing 01</p> <p>(*) Fans &amp; Blades 01</p> <p>(+) Heat Shields 01</p> <p>(*) Gear box 01</p> <p>(iv) <u>Manne</u></p> <p>(*) Small boats 02</p> <p>(+) Boat hulls 02</p> <p>(v) <u>Space Hardware</u></p> <p>(+) Heat Shields 02</p> <p>(+) Nose Cone 02</p> |                 |
|                 | <p><u>Bing</u><br/>21/11/19<br/><u>Staff Incharge</u></p> <p><u>Reviewer</u><br/>21/11/19</p> <p><u>HOD</u><br/>21/11/19<br/><u>(V Rajan)</u></p>  |                 |

PROFESSOR & HEAD  
Department of Aeronautical Engineering  
S.J.C. Institute of Technology  
CHICKBALLAPUR-562191







40  
41  
42

|   | CO1  | CO1  | CO2  | CO3  | CO3  | CO3  | CO5  | CO1  | CO2  | CO3  | CO3  | CO4  | CO5  | CO1-CO5 | CO1-CO5 | CO1-CO5 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|------|---------|---------|---------|
| Total No. of Students   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39   | 39      | 39      | 39      |
| No. of students absent  | 2    | 2    | 2    | 1    | 1    | 1    | 1    | 0    | 0    | 0    | 0    | 0    | 0    | 0       | 0       | 0       |
| No. of Students scored above 60% in IA /90% in assignment/ 40% in | 36   | 33   | 31   | 37   | 34   | 38   | 34   | 38   | 35   | 38   | 38   | 38   | 39   | 42      | 39      | 38      |
| % of Students scored above 60% in IA /90% in assignment/ 40% in   | 0.97 | 0.89 | 0.84 | 0.97 | 0.97 | 1.00 | 0.89 | 0.97 | 0.90 | 0.97 | 0.97 | 0.97 | 1.00 | 1.00    | 1.00    | 0.97    |

|         | CIE  | LEVEL | SEE  | LEVEL | DIRECT | INDIRECT | TOTAL | Indirect Assessment - Course End Survey  |        |          |            |            |        |       |  |  |
|---------|------|-------|------|-------|--------|----------|-------|--|--------|----------|------------|------------|--------|-------|--|--|
|         |      |       |      |       |        |          |       | Excellent -                              | Very   | Good - 3 | Satisfacto | Unsatisfac | No. of | TOTAL | co attainment indirect(o n a scale of 5) | co attainment indirect(o n a scale of 3) |
| CO1     | 0.93 | 3.00  | 1.00 | 3.00  | 3.00   | 2.78     | 2.98  | 21.00                                    | 19.00  | 19.00    | 18.00      | 20.00      | 20.00  |       |  |  |
| CO2     | 0.87 | 3.00  | 1.00 | 3.00  | 3.00   | 2.73     | 2.97  | 12.00                                    | 13.00  | 12.00    | 12.00      | 13.00      | 13.00  |       |  |  |
| CO3     | 0.98 | 3.00  | 1.00 | 3.00  | 3.00   | 2.71     | 2.97  | 0.00                                     | 1.00   | 2.00     | 3.00       | 3.00       | 0.00   |       |  |  |
| CO4     | 0.97 | 3.00  | 1.00 | 3.00  | 3.00   | 2.67     | 2.97  | 0.00                                     | 0.00   | 0.00     | 0.00       | 0.00       | 0.00   |       |  |  |
| CO5     | 0.95 | 3.00  | 1.00 | 3.00  | 3.00   | 2.76     | 2.98  | 0.00                                     | 0.00   | 0.00     | 0.00       | 0.00       | 0.00   |       |  |  |
| AVERAGE |      |       |      |       |        | 2.73     | 2.97  | 33.00                                    | 33.00  | 33.00    | 33.00      | 33.00      | 33.00  |       |  |  |
|         |      |       |      |       |        |          |       | 153.00                                   | 150.00 | 149.00   | 147.00     | 152.00     | 152.00 |       |  |  |
|         |      |       |      |       |        |          |       | co attainment indirect(o n a scale of 5) |        |          |            |            |        | 4.61  |  |  |
|         |      |       |      |       |        |          |       | co attainment indirect(o n a scale of 3) |        |          |            |            |        | 2.76  |  |  |

|   |       |
|---|-------|
| CO attainment Internal Assessment                                 | 3     |
| CO attainment Semester End Exam                                   | 3     |
| Direct CO attainment (IA+SEE)=(0.4*CIE+0.6*SEE)                   | 3     |
| Indirect CO attainment  | 2.73  |
| Overall CO attainment (Direct+Indirect)=(0.9*Direct+0.1*Indirect) | 2.973 |

|     |  |
|-----|--|
| CO1 | Understand the concept of composite materials over monolithic materials, as well as some basic knowledge about constituents of composite materials |
| CO2 | Study the different fabrication techniques used to investigate the PMC, CMC and MMC  |
| CO3 | Analyze the problems on micro-mechanical and macro-mechanical behavior of lamina   |
| CO4 | Predict the failure strength of a laminated composite plate and identify the suitable machining method for a given type of laminate                |
| CO5 | Examine the failure analysis using Destructive and Non Destructive testing, and find suitable applications   |

| CO-PO & CO-PSO MAPPING MATRIX |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|                               | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 | P010 | P011 | P012 | PSO1 | PSO2 |
| CO1                           | 3   | -   | -   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO2                           | 3   | -   | 3   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO3                           | 3   | 2   | -   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO4                           | 3   | 2   | 3   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| CO5                           | 3   | -   | -   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |
| Average                       | 3   | 2   | 3   | -   | -   | -   | -   | -   | 2   | 2    | -    | 2    | 1    | 1    |

| Attainment LEVEL |      |
|------------------|------|
| CO1              | 2.98 |
| CO2              | 2.97 |
| CO3              | 2.97 |
| CO4              | 2.97 |
| CO5              | 2.98 |

|         | P01  | P02  | P03  | P04 | P05 | P06 | P07 | P08 | P09  | P010     | P011 | P012 | PSO1 | PSO2 |
|---------|------|------|------|-----|-----|-----|-----|-----|------|----------|------|------|------|------|
| CO1     | 2.98 | -    | -    | -   | -   | -   | -   | -   | 1.99 | 1.985455 | -    | 1.99 | 0.99 | 0.99 |
| CO2     | 2.97 | -    | 2.97 | -   | -   | -   | -   | -   | 1.98 | 1.981818 | -    | 1.98 | 0.99 | 0.99 |
| CO3     | 2.97 | 1.98 | -    | -   | -   | -   | -   | -   | 1.98 | 1.980606 | -    | 1.98 | 0.99 | 0.99 |
| CO4     | 2.97 | 1.98 | 2.98 | -   | -   | -   | -   | -   | 1.98 | 1.978182 | -    | 1.98 | 0.99 | 0.99 |
| CO5     | 2.98 | -    | -    | -   | -   | -   | -   | -   | 1.98 | 1.984242 | -    | 1.98 | 0.99 | 0.99 |
| Average | 2.97 | 1.98 | 2.97 | -   | -   | -   | -   | -   | 1.98 | 1.98     | -    | 1.98 | 0.99 | 0.99 |